Aeronautics

S-M

formerly **POPULAR AVIATION**

Largest Selling Aeronautical Publication in the World

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Naturaline functions just as uniformly in the North as it does in the South, *climate makes no difference.*

PITCAIRN AVIATION, INC.

Mr. James G. Ray of Pitcairn Aviation, Inc., wrote to us in appreciation of Naturaline, as follows:

"We have been using Naturaline on our New York-Atlanta Airmail line for several months and find it very satisfactory. We find that our motors run considerably smoother than they did on domestic aviation gasoline and that they develop about 25 to 50 more revolutions. Also our consumption is running less per hour—your distribution has made it possible for us to procure Naturaline at a very reasonable price."

Pilots flying these mail routes can always depend on securing Naturaline at these mail stations.

GULF AIRLINES, INC.

Mr. Wm. H. DeWald of the Gulf Air Lines wrote to us in appreciation of Naturaline, as follows:

"We have found that our motors run much smoother on Naturaline than on the regular domestic aviation grade of fuel and also that they run cooler which is a very important factor in this warm country. These features, coupled with the fact that it weighs one-half pound per gallon less than specification gasolines influenced us to adopt Naturaline for use on our lines and our experience with it to date has been very satisfactory from every standpoint."

Naturaline starts a cold motor quickly.

Naturaline is a perfectly balanced fuel.

Naturaline is uniform at all times.

Naturaline weighs ½-lb. per gallon less than ordinary domestic aviation gasoline.

Naturaline will increase the R. P. M. from 25-50 depending upon type of motor.

Naturaline saves in fuel consumption from 5-15% depending upon type of motor.

Naturaline has an anti-knock value equivalent to 48% pure benzol.

Naturaline will reduce motor overhaul costs.

NATURALINE

NATURALINE
Company *of* America
Chestnut & Smith Bldg.
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WHY COASTAL AIRWAYS' *six new seaplanes are all FAIRCHILD "71's"*

One of the six Coastal Airways' Fairchild seaplanes taking off for Albany

COASTAL AIRWAYS, INC., has just bought six new pontoon-equipped Fairchild "71's" for exclusive use on its New York-Albany-Lake George service.

Let Mr. F. W. Dalrymple, President of Coastal Airways, Inc., and an authority on over-water flying, tell why Fairchilds were selected. He says:

"We chose Fairchilds in the first instance because we had to have seaplanes. Fairchild has equipped more ships with pontoons and is more conversant with seaplanes than any other manufacturer.

"Fairchild pontoons have just the features that our service demands. To begin with, they are interchangeable. They have a special compartment in the pontoon for stowing the anchor. Finally, the axle holes in the pontoon permit of slipping on beaching wheels, thus avoiding the necessity of the use of dollies to bring the plane into the hangar.

"Fairchild planes have a reputation for rugged construction and for dependability, comfort and convenience.

"Fairchild has the further advantage of thoroughgoing service so that maintenance needs can be quickly supplied.

"But, above and beyond all this is the fact that Fairchild has folding wings. Property values on the New York waterfront are so high that we are faced with the problem of economizing space in every possible way in our New York hangar. Fairchild folding wings permit an economy of space which made it inevitable that we must choose Fairchild '71'."

These reasons why Coastal Airways selected Fairchild exclusively are significant reasons for every operator of land planes or seaplanes who aims to provide dependable and comfortable transportation to the public and to realize increased profits from his operations.

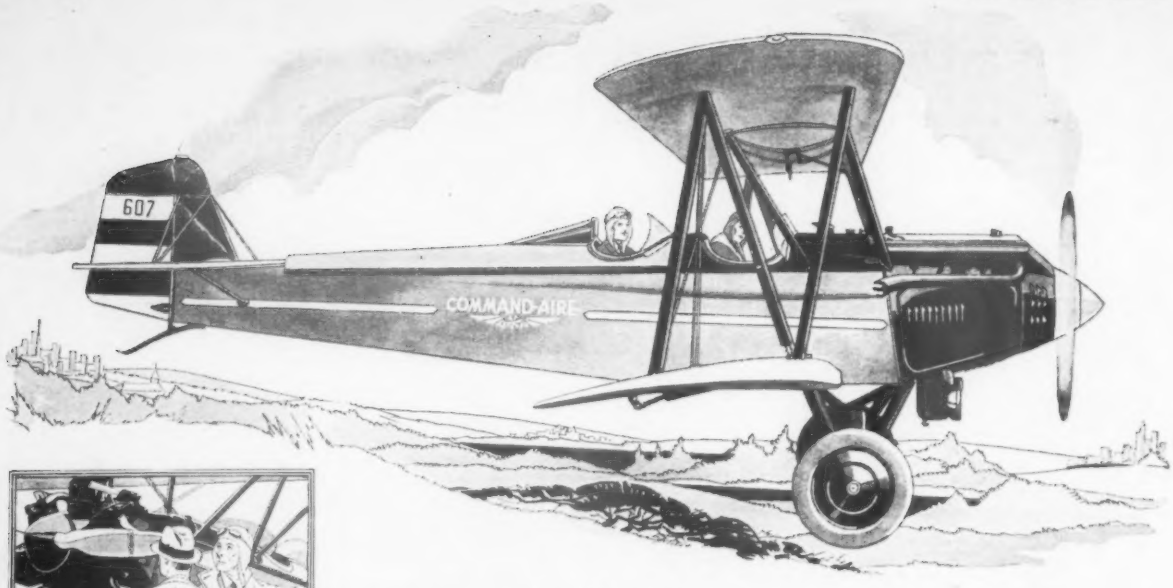
FAIRCHILD AIRPLANE MANUFACTURING CORPORATION
FARMINGDALE, L. I., NEW YORK

District Offices: 332 S. Michigan Ave., Chicago; 2102 N. Harwood Ave., Dallas; 228½ E. 11th St., Los Angeles. *In Canada:* Fairchild Aircraft Ltd., 505 Confederation Bldg., Montreal, P. Q.

FAIRCHILD

AIRPLANES

Entered as second class matter January 23, 1929, at the post office at Chicago, Illinois, under the Act of March 3, 1879.



Your hours pay bigger dividends by air . . .

BE it in time saved for business, or in time gained for pleasure. For flying has reduced days to hours—translated miles into moments—multiplied contacts for the executive—expanded the salesman's range—brought distant buyers into personal touch and quickened the cadence of commerce.

For you who question flying as practical—COMMAND-AIRE will banish doubt. Indeed not mere assertion but sound assurance founded upon eminent engineering*—assurance justified by amazing stability† in the air, giving you relaxed confidence your first time up—assurance underwritten by the splendid performance of COMMAND-AIRES now in service.

Wherever transportation plays a part in your daily affairs, COMMAND-AIRE brings you bigger dividends—In more dollars from your effort—in putting infinitely more time at your disposal—in the sheer zest of air travel—in pride of possession in a smart, powerful, able ship.

Let us help you collect these dividends to be clipped from the boundless horizon. You can own a COMMAND-AIRE from $3,350 to $6,325—factory, powered by aviation's finest motors. See our nearest distributor, as listed here, or write us direct for complete information and literature.

COMMAND-AIRE, INC., *Little Rock, Arkansas*

General Distributors

CURTISS FLYING SERVICE, Inc.

27 W. 57th St., New York City, who handle Command-Aire at their 15 airports and in co-operation with the Distributors shown.

INDIANAPOLIS, IND.
Silver Wing Aircraft Corp.
802 South Delaware Street

SPRINGFIELD, MASS.
Eastern States Aircraft Corp.
134 Dwight Street

NEW YORK CITY
Eastern Aeronautical Corp.
Graybar Building

CHICAGO, ILLINOIS
Aviation Service & Transport Co.
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Congressional Airport, Inc.
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Command-Aire Sales Corp.

***COMMAND-AIRE'S** Chief Engineer, Albert Volmecke, came direct to us from 12 years with Heinkel of Germany, one of Europe's largest and most successful builders of air transport. COMMAND-AIRE engineering embraces exclusive superior features found in no other plane.*

† COMMAND-AIRE test pilots leave the cockpit and ride the fuselage "bare-back" while the plane flies on under perfect self-control. This is in no sense a stunt but an everyday demonstration of COMMAND-AIRE'S trustworthy stability.

COMMAND-AIRE

XUM

America's Largest Commercial Transport is BERRYLOID-Finished

The Boeing "80", largest commercial air transport plane in operation in the United States, is finished throughout with Berryloid Aircraft Finishes. This multi-motored passenger-carrying ship has a wing span of 80 feet.

Selection of Berryloid for this plane is in strict accordance with the standard practice of the Boeing System. Progressive Aircraft Finishes are used on the San Francisco-Chicago air mail route, known as "the longest airplane laboratory in the world". Here ships and finish must withstand temperatures ranging from 30 degrees below zero to 135 above.

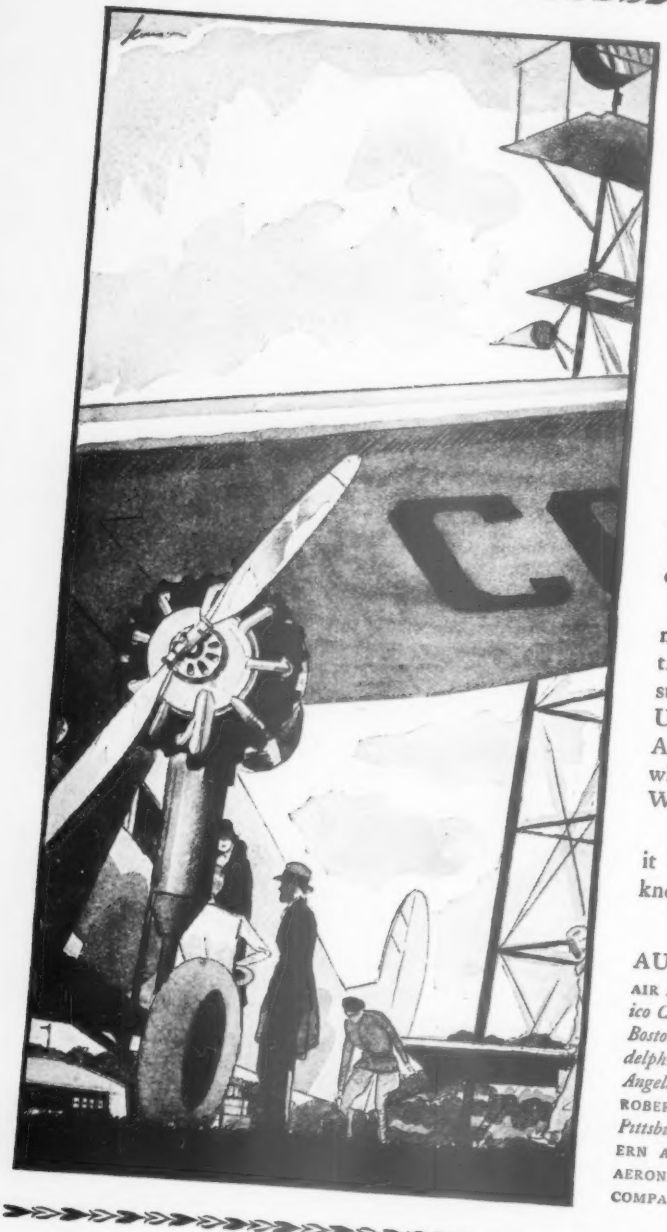
Few aircraft manufacturers or airline operators will overlook such evidence as this. Berry Brothers aircraft finishes are tried and proven. Our aviation division will gladly serve you. Write for information or have an experienced representative call.

Members Aeronautical Chamber of Commerce

Manufacturer of Progressive Aircraft Finishes

BERRY BROTHERS
Varnishes Enamels Lacquers
Detroit, Michigan *Walkerville, Ont.*

TO THE GROWTH OF AIRPORTS



THE number of excellent flying fields in America is increasing so rapidly that even in listing them the Department of Commerce has difficulty. Something of the same sort is true of Wright engines. The average man thinks automatically of Wright when he thinks about aviation. The public knows that it was in a Wright-powered plane that Lindbergh made his memorable visit to Paris and it is with Wright engines that most of the famous trans-oceanic flights have been made.

Wright engines . . . and modern, conveniently located airports . . . have done as much as any other factors to build up confidence in flying.

Statistics show that approximately thirty-five per cent of all the airplanes in America are powered by Wright. This, of course, is most impressive proof of Wright efficiency and safety.

Ninety-four per cent of the parts for "Whirlwind" motors are interchangeable. And the twelve regional distributors listed in this advertisement carry as complete a stock of Wright parts as can be found at our factory. Under these distributors a large and growing number of Approved Service Stations function. They network the whole country, and as new airports are established, new Wright Service Stations come into existence.

The list of Wright distributors is printed here to make it easy for flyers, owning Wright-powered planes, to know where spare parts can be quickly obtained.

• • •

AUTHORIZED REGIONAL PARTS DEALERS:

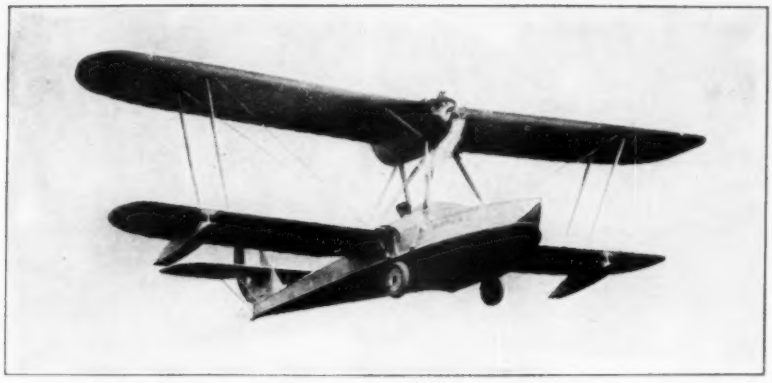
AIR ASSOCIATES, INC., *Curtiss Field, L. I., N. Y.*; H. C. BARRU, *Mexico City, Mexico*; EAST COAST AIRCRAFT SALES CORP., *Boston Airport, Boston, Mass.*; LUDINGTON PHILADELPHIA FLYING SERVICE, *Philadelphia Airport, Pa.*; PACIFIC AEROMOTIVE CORP., *Mines Field, Los Angeles, Cal.*; PITCAIRN AVIATION COMPANY, *Atlanta, Georgia*; ROBERTSON AIRCRAFT CORP., *Anglum, St. Louis, Mo.*; SERVAIR INC., *Pittsburgh, Pa.*; STOUT AIR SERVICE, INC., *Dearborn, Mich.*; SOUTHERN AERONAUTIC SERVICE, INC., *Fort Worth, Texas*; THOMPSON AERONAUTICAL CORP., *Cleveland, Ohio*; WATKINS MANUFACTURING COMPANY, *Wichita, Kansas.*

WRIGHT

AERONAUTICAL CORPORATION

PATERSON, NEW JERSEY

WRIGHT AERO



AERONAUTICS

FORMERLY
POPULAR AVIATION
608 South Dearborn Street, Chicago

July, 1929 Vol. 5, No. 1

CONTENTS

From the Publisher's Quill 9
Crushing America by Air 11
By General William Mitchell
The Airplane Finds Oil 16
By Kent Sagendorph
Airports vs. Landing Fields 19
By Lieut. Commander James M. Shoemaker, U. S. N.
Know Your Weather 22
By M. L. Dobler
Large Scale Operations of 10-Passenger Airplanes 25
By Archibald Black and George F. Wheeler
What's Doing in Washington 30
By Fred DeWitt Shelton
Monthly Financial Review 32
By J. Allen Grover
The Lady Heath Cup Contest 33
Flight Training the Navy 34
By K. M. Painter
Latin America's First Birdmen 38
By H. H. Dunne
I Could Fly—Just Give Me a Plane 48
By Kathryn Ward
Simple Aerodynamics 54
By Alexander Klemin
Sky Pilotage 62
By Commander Douglas G. Jeffrey, R. N. R.
Sailplane Construction 70
By Alfried Gymnich
A Compressed Air Model 76
By Bertram Pond
Fire! 83
By Paul Scott
Directory 92
Patent Department 94
Index of Advertisers 98

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Member Audit Bureau of Circulations

WACO "165" STRAIGHT-WING

TO meet a widespread demand WACO offers the "165"—a notable combination of a great airplane with a great engine . . . top speed 125 and better . . . remarkably easy on the controls . . . typically "Waco" at getting in and out of small fields . . . and moderately priced.

See it, by all means; you will be impressed. *Fly* it; you will be *sold!*

THE ADVANCE AIRCRAFT COMPANY
TROY, OHIO

SPECIFICATIONS

WACO "165" Straight-Wing
J-6 Wright "Whirlwind" Motor
(165 H.P.-5 cyl.)
Wood propeller
Bendix brakes
Navigating equipment
65 gal. gas tank
3-place . . . Dual controls
Customer's choice of colors

$6370

(With metal propeller $275 additional)
Further details on request

WACO AIRPLANES

"ASK ANY PILOT"

WE are preparing a book about the formation of Flying Clubs. If interested, we suggest that you reserve your free copy now.

From the Publisher's Quill

"Simple Duty Hath No Place for Fear" —*John G. Whittier*

The City of Wichita

Aeronautics Program Includes:

A unified air service

An appropriation comparable to army, navy and commercial appropriations

A great National Air Academy at Wichita, Kansas

AERONAUTICS intends to stick it out to the last guns for the program carried at the top of its editorial column.

We have carried articles by General Mitchell and others showing clearly the crazy and dangerous situation our Uncle Samuel is in as the result of the smug and complacent inertia with which our Government officials are chloroforming aviation progress.

Where other well meaning and informed citizens open their mouths on this burning subject and lose their jobs or contracts in consequence, the worst that can happen to us is to have a few controlled companies cancel their advertising. This does not alarm us in the slightest and we will continue to flourish in spite of this type of childish gesture.

We advocate the city of Wichita as the logical place for a new great military academy. Our reasons are briefly as follows:

Wichita is air minded. It buzzes with aeronautical activity. The whole city, civic organizations and private citizens, is behind our program solidly, if the enthusiastic support tendered the writer a few weeks back is any indication. With Wichita goes the state of Kansas in support of a necessity which has recently almost had the earmarks of a lost cause. Some day the whole nation will breathe a vote of thanks to this intelligent air minded city, if this support can form a nucleus for a determined effort to put over a unified air service.

Wichita is a beautiful place and would be a good atmosphere for the type of young men who would be trained to be our future aeronautical admirals. Its flying weather has just the right mixture of perfection and difficulty for sound training in the air. And last, a school of this sort should be located in the Middle West near the center of the nation, both for reasons of public policy and inaccessibility to attack.

Men with the good of the nation at heart will back this program solidly. We expect other cities patriotically to sacrifice self interest in support of this highly important forward move.

This nation is determined on a unified air service, air supremacy, rapid commercial development of the airways, and a new great military college of the air.

A movement of this sort requires concerted support and proper organization. We are taking the initiative and going ahead.

Comment in this time of flux is valuable and we would appreciate all constructive criticisms or suggestions.

AERONAUTICS Again Leads the Way

AERONAUTICS has been for a long time the leader in the aviation field, possessing a circulation far in excess of that of any competitor.

We have endeavored to build this magazine according to the standards of highest quality.

We feel that a large responsibility rests with us as the unquestioned leader in this great field, and in a miasma of chaos we have endeavored to light the way to higher standards of ethics and stability.

AERONAUTICS was the first aviation magazine to become a member of the Audit Bureau of Circulations. AERONAUTICS again led the way when it established an advertising advisory board which would serve to pass upon the advertising messages submitted for our columns.

AERONAUTICS separated the business and advertising departments from the editorial departments, refusing to accept highly colored messages, posing as genuine news articles, from advertisers.

We are the largest selling aeronautical publication in the world, largely because we put truth, honesty and courage above all else.

AERONAUTICS was first to break through the wall of ridiculous twaddle surrounding the industry and at imminent risk of offending powers who controlled advertising appropriations, spoke what seemed to us to be the dangerous truth of today's situation.

These things have been costly, but AERONAUTICS in spite of innuendo of those who cannot stand competition or daylight, is still parading with its banner high.

Once again AERONAUTICS accepts its call to duty and leads the way to better standards.

The following notice has gone forward to all flying schools advertising in our columns:

"In order to co-operate with the Aeronautics Branch of the United States Department of Commerce in an effort to eliminate any flying school that can be regarded as unsafe or unreliable, AERONAUTICS will not accept any advertising from flying schools which have not applied for a rating with the Department of Commerce.

"Effective with our August, 1929, issue, all flying school advertising must carry in it the rating given it by the Department of Commerce, and in cases where this rating has not been received by the flying school the following clause can be carried temporarily: 'Examination and rating by the Department of Commerce applied for.'"

AERONAUTICS sets these standards with the ardent desire that the industry will be bettered thereby, and with full faith in the idea that service and honor are their own rewards.

Wild-Eyed Propaganda

THE plain facts of aviation continue to be distorted in our daily press in the usual sensational way. The partial reproduction (on page 87) from a front page article in a newspaper which claims to be the world's greatest is revealing. On the same page were several other juicy accounts of air accidents and deaths related in such a way as to throw the wife of every business man into hysterics at the very idea that her husband might contemplate using one of the murderous chariots commercially.

The make of plane and engine, which we have deleted, was presented in such a way as to make them second cousins to a time bomb wrapped up as a box of candy.

As a matter of fact the fatalities of the air in ordinary commercial usage are actually smaller by relation to mileage covered than any other known vehicle, including buggies, automobiles and brogans. A partial daily account of automobile fatalities would wipe everything else off of the front page and a lot of inside pages too.

(Continued on page 87)

AIR-MINDED AMERICA

-TP- Aero Valve Spring Lubricant

For Valves, Springs, and Valve Guides. Stays on—Does not burn or carbonize. Send 50c for ½ pint trial can.

-TP- Aero Rocker Arm Lubricant

A pure, paraffine-base, low-cold-test, mineral-oil lubricant. Free flowing—will not carbonize. Send 50c for 1-pint trial can.

THINGS that contribute to the safety of flying add most to its popularity. -TP- Oils add to the safety of flying. When the public thoroughly knows the story of -TP- Aero Motor Lubricating Oil, people will fly with greater confidence knowing that -TP- is in the engine.

-TP- Oils are new—the latest development in scientific lubrication. They have been tested and approved by leading manufacturers of airplane engines and by many leading pilots. They are straight-run oils, not blended or compounded, produced from pure, paraffine-base crude by a process for which patents are pending.

This process has marked advantages over other methods. It removes all the paraffine wax, while preserving all the lubricating bodies in the crude. Elimination of the wax is responsible for its low cold test.

In terms of performance this means uniform viscosity at all working temperatures, minimum carbon deposit and ignition trouble from fouled spark plugs, easy cold priming, immediate oil pressure, perfect lubrication winter and summer, on the ground or at high altitudes—a maximum of safe flying hours.

A handsome, practical *Pilot's Log Book* sent free on request. Please use the coupon.

TEXAS PACIFIC COAL AND OIL COMPANY
FORT WORTH, TEXAS
New York St. Louis Los Angeles

-TP- AERO MOTOR LUBRICATING OIL

PATENT PENDING

Aeronautics 7-29

Texas Pacific Coal and Oil Company, Fort Worth, Texas

Please send me, without obligation, your Pilot's Log Book.

Name_____ Address_____

Your Oil Dealer's Name_____

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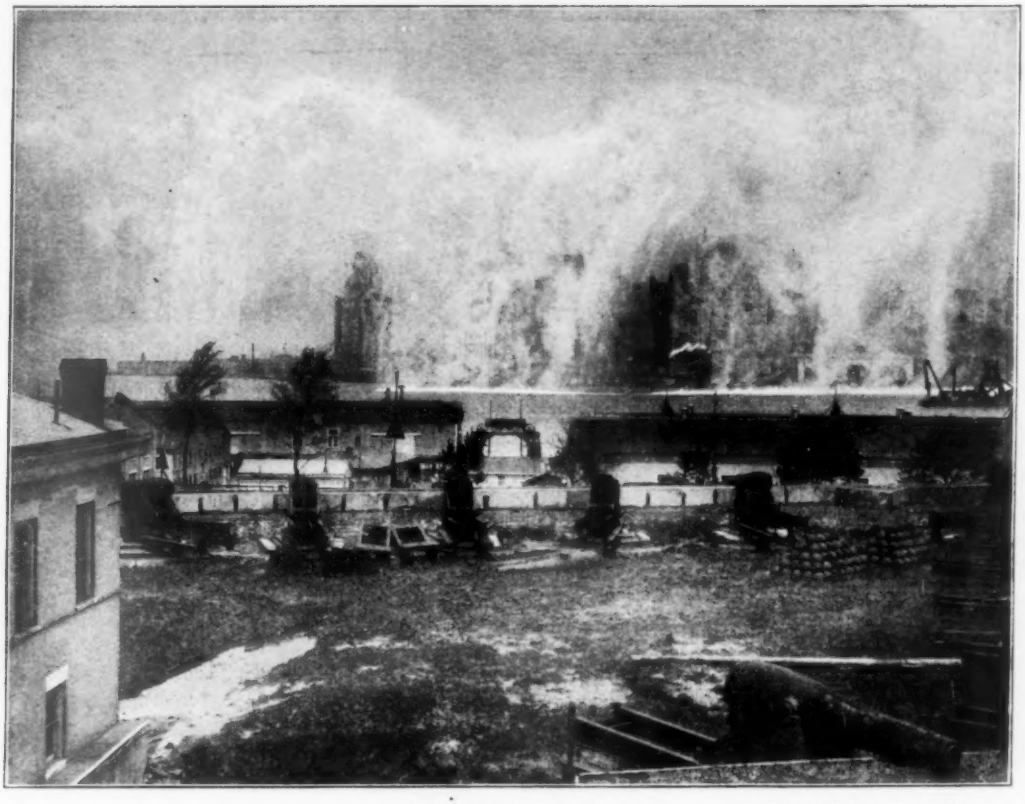


New York Gassed! Photo Copyright, International Newsreel.

Crushing America by Air

By General William Mitchell

Former Commander, Air Forces, A. E. F., and Director, Military Aeronautics, U. S. Army

EVERY airplane built is an asset for national defense. Each and every one, no matter whether it is called military or commercial, can be used in wartime, either for actual combat or transportation of goods and material, or for the training of pilots. Every air mechanic employed on commercial airways is efficient in case of war. Every airway, every landing field, all the aids to aerial navigation and the weather service, are assets.

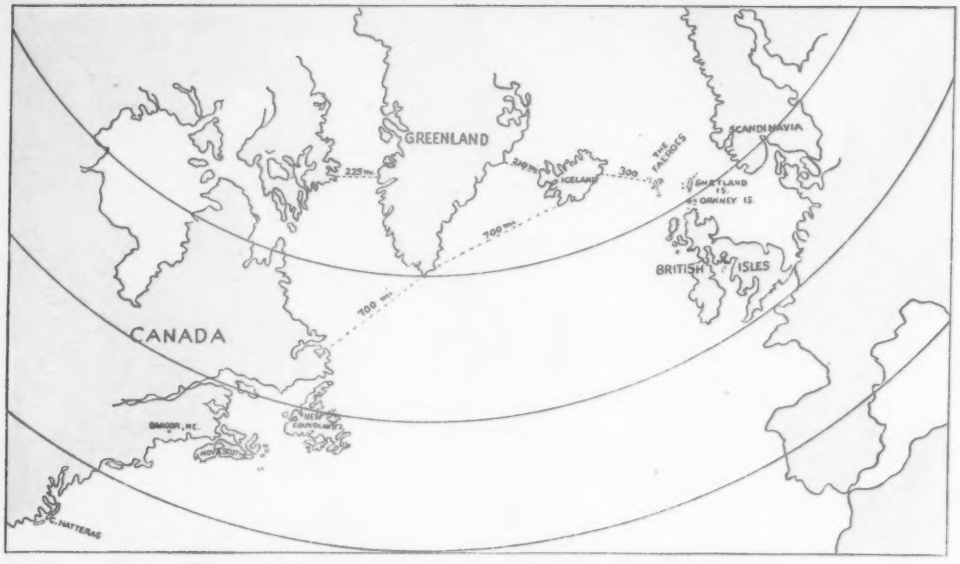
The tremendous military value of air power has burst on the world so suddenly that its realization is difficult for the average citizen. The idea is deeply ingrained into most of us that armies and navies must always conduct our wars, because they have done so from time immemorial. Such, however, is by no means the case today.

The army has lost its mobility and with it the power of effecting a quick decision. To bring a war to a successful conclusion, the vital points of the enemy must be seized or controlled, so as to prevent him from living in his accustomed way and carrying on his usual functions of government. Armies were opposed by other armies in the accomplishment of this task. In other words, walls of men were put up in front of the great cities and vital centers to protect them. In the days when populations were not as great per square mile as now, and it was difficult to support armies, the small forces employed were capable of considerable movement, but as time went on the armies grew larger and larger, became more immobile and unwieldy, and incapable of striking or acting quickly.

The distance from Washington to Richmond, Virginia, is 121 miles. In the Civil War, it took the Union Army about five years to get there. An airplane would have covered the distance in less than one hour. In the European war, the armies faced each other along a 250 mile front. They went backward and forward for about sixty miles until the end of the contest. Men were killed by the thousands by machine gun fire, they were shot up with cannon, stuck with bayonets and devoured by disease. This modern and "humane" warfare could only result in one thing, the utter destruction of all the participants in such a combat. It ceased to be war and was merely a slaughterhouse performance in which no science, art or ingenuity was involved. The European war, except for a few battles at the beginning, was one of the most uninteresting that history gives us.

Armies have now reached a stalemate and the old theory of war, that victory meant the destruction of the hostile main army, is untenable. The idea behind this was that once the army was destroyed, all the vital centers of the opposing country lay open to the invader. Now, however, armies have become mere holders of ground and air power is the only thing that can go quickly and surely to the vital centers of the enemy. If you tie aviation to an army, you are going to stop its effectiveness at once.

Suppose, for instance, that Chicago and New York were the capitals and vital centers of two opposing states. They are about 800 miles apart. Sup-



The northern route across the Atlantic makes the United States vulnerable to aircraft attack. There is no water jump longer than 700 miles, and the hops could be shortened.

pose that the military force of Chicago consisted of a great army of one million men with only aviation enough to act as a means of reconnaissance and observation for its infantry and artillery. Suppose that the army of New York consisted of 100,000 men but that they had an air force of 1,000 airplanes capable of flying to Chicago and back, and each capable of carrying two tons of projectiles, air torpedoes, bombs, gas projecting apparatus and guns. Suppose this force were launched at Chicago, with 2,000 tons of projectiles. They would make the trip in seven hours. They could not only force the evacuation of the city and set on fire all the towns and manufacturing plants around Chicago, but could throw gas over the fields where cattle and other livestock lived, destroying all of them. They could drop chemicals on the fields which would destroy all vegetation and even prevent their use for agriculture for a considerable time. The gas would affect all water supplies, even rivers and lakes. The result of such an attack would be absolutely decisive. The armies would be powerless to avert it and nothing could stop it except other airplanes taking the offensive against the enemy at the same time.

The old services put up a howl that this kind of war is inhumane, but can anything be worse than the long protracted torture to which armies and peoples are exposed when a war is carried on in the present accepted fashion? Air power will get a quick decision. The mere threat of its use may be sufficient to force a peace.

Let us suppose that war occurs between a nation on a continent, such as Europe, and one situated on an island or series of islands, such as England or Japan. Both these empires depend almost entirely for their existence on their overseas commerce. As most of their people have been called into the industrial centers to manufacture goods which they sell, there are very few left for the production of food and the necessities of life.

Great Britain is a direct descendant of the Phoenician system. This comprises a series of armed ports throughout the world into which the raw materials of the various countries are gathered. These materials are picked up, put into boats and transported to Great Britain where they are manufactured into articles of trade and then distributed to the world from ships. To break down these trade routes at any place, for instance, the English trade routes through the Mediterranean and the Suez Canal, would be her downfall. Similarly, the breakdown of the trade routes through the China Sea and the Straits of Malacca would have a corresponding effect on Japan.

Air power is entirely capable of breaking down these lines of communication by sinking the ships and causing the evacuation of the ports. An attack by air power on islands such as those comprising Great Britain and Japan would be decisive because the people have no place to go and nowhere to get food except on these comparatively small stretches of land. It is doubtful if a two months' reserve supply of food exists in Great Britain. The targets are well defined, easy to pick up and tremendously easy to hit. Both these nations thoroughly realize this and both have organized great air forces which are entirely independent of the Army and Navy and are charged specifically with the defense of all the air over their respective countries, and with making air attacks against enemy countries.

In all the leading countries, air, land and water are under independent ministries, which are brought into one organization, either a department of national defense with a secretary or minister at its head, or under a committee that handles the whole war-making system of the state. In this way coordination is secured and each branch of the service has its own voice in the scheme.

In England, the Air Commander has charge of all defense arrangements for the British Isles in case of war and the actions of the army and navy within 200 miles of the coast will be coordinated under his direction. In other words, the head airman is the supreme commander of all forces in case England is attacked.

I mention England, particularly, because they received very heavy casualties and damages from aircraft bombs during the war, which brought home to them the realization of what would happen in another war. England started in the World War with an Army Air Service and a Navy Air Service, just as we have in the United States now. When the German airplanes raided England, the Army Air Service would chase them to the shores of the sea, at which point they would have to turn around and go back. The Navy Air Service was then supposed to take up the pursuit but they were never there, so the result was that the Germans got away safely. The British soon put a stop to this state of affairs by creating a Ministry and an Independent Air Force.

In the United States today, there is an indescribable mess about the defense arrangements all along our coast and in the interior. Nobody knows who has charge of anything. There is no air commander and no similarity of instruction between the Air Services of the Army, Navy, Marines or Coast Guard. There is no air force whatever.

From the Navy we have heard a great hue and cry about the Washington Conference for the Limitation of Armaments, brought about in 1921, and how adversely it affected the United States. The fact is that nothing in the history

XUM

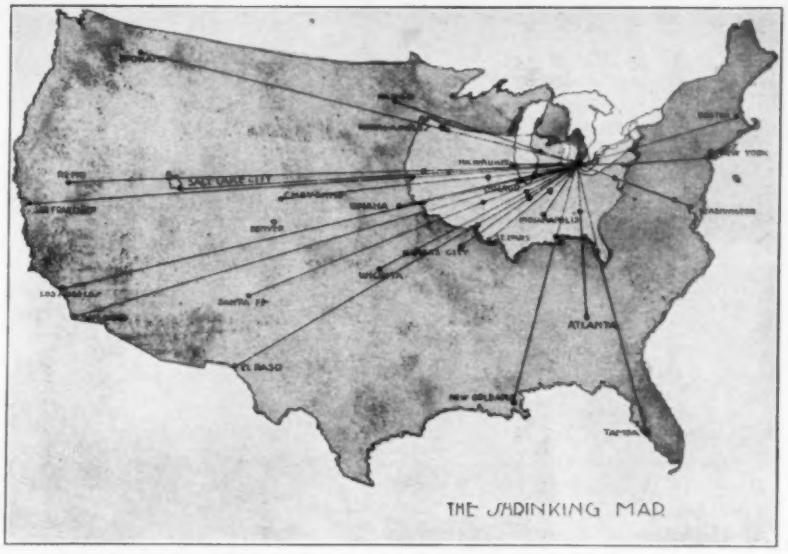
of the world has done more toward the reduction of useless and expensive armaments than the calling of this conference by Secretary of State Hughes during the Harding administration, and the results it obtained. It has saved millions to the tax payers of all the countries involved and has shown people what can be done under certain conditions with an accord between different nations on the subject of disarmament. The influence of air power had much to do with this.

It will be remembered that we sank the battleships with airplanes in peacetime tests in 1921, a few months before the Limitations of Armaments Conference was called by the United States. The board of Army and Navy officers headed by General Pershing that witnessed these tests put in their findings:

"Aircraft carrying high-capacity, high explosive bombs of sufficient size have adequate offensive power to sink or seriously damage any naval vessels at present constructed, provided such projectiles can be placed in the water close alongside the vessel. Furthermore, it will be difficult, if not impossible, to build any type of vessel of sufficient strength to withstand the destructive force that can be obtained with the largest bombs that airplanes may be able to carry from shore bases or sheltered harbors."

This finding had a distinct bearing on the Conference for the Limitation of Armaments. The Navy flooded the country with propaganda that it seriously crippled our national defense. As a matter of fact, it made us much better off because the ships that we were building not only were surface battleships completely at the mercy of airplanes but even at that they were to be equipped with 16″ guns, whereas the British had ships projected to carry 18″ and 20″ guns, and the Japanese would have followed the lead of the British. They would have waited until we had built a lot of old tin ships with obsolete armaments, then they would have come out with new and improved ships and we would have had to repeat the performance. As long as the leading maritime nations can encourage us to build a navy and keep down our air force, they have a great advantage, because they are creating huge air forces that will be effective.

The same conditions continue here. Our country was flooded with navy propaganda about building cruisers, during the last winter; incidentally, the air people were not allowed to flood the country with air propaganda about how easily these things could have been sunk; and how, if the money were applied to the construction of commercial and military aircraft, a much greater asset for the defense of our country would be obtained. This state of affairs exists because we have no separate department



The dark portion represents the size of the United States when the railroad was the fastest means of transportation as compared to the red portion representing the size with aircraft as the swiftest transportation.

of aeronautics and the Navy and Army either prohibit all propaganda about air power, or distort the truth about it.

The Navy, with their lobby in Washington, pushed a provision through Congress for cruisers. These cruisers are steam vessels capable of cruising about 10,000 miles at 13 knots and carrying 8″ guns. The paper and ink had hardly dried with the President's signature to this appropriation act, when it became known that the Germans already had in existence a 10,000 ton cruiser capable of going 10,000 miles at 20 knots, carrying six 11″ guns in triple turrets with mountings permitting a very high angle of elevation, and eight 5.9″ guns behind shields. This ship also carries six 19.7″ torpedo tubes on triple carriages, one at each side of the quarter deck. The big guns of this vessel have a loading gear of a new pattern which enables a very rapid rate of fire to be maintained. Their range is 30,000 yards. The ship is driven by internal combustion oil engines which are said to weigh only 17½ pounds per horsepower. One of these German cruisers could stand off and whip the whole force of steam cruisers that the United States authorized last winter. Not only can this single German ship defeat them any place it can find them but it can sail across the Atlantic a couple of times and do it.

What absolute bone-headedness has been displayed! How utterly inefficient the national defense system is which will allow such a condition to exist. The American people have no knowledge of how they are being duped by the Navy Department in Washington, and the people who sell coal, steel and supplies to the Navy. The cruisers authorized have no value whatever in national defense. Have we stopped the building of these worthless vessels and adopted types superior to anything else? No, we go ahead spending billions and all the Navy says is that we must limit the Germans so that they cannot build such ships!

Good submarines are extremely necessary, but our submarines are the worst in the world, and as long as it is left to such an organization as our present Navy Department to perfect them, we shall never have good ones.

At the present time we spend about one-third of our total national income in arrangements for national defense or payment for past wars. Of the amount actually appropriated for military purposes, the Navy gets about 50%, the Army about 40% and the aviation, which is split up between the Army and Navy, about 10%. Even if the money for aviation were spent wisely, which it is not, it would go a long way, but so much is used up in useless overhead and inefficient organization that the funds are largely wasted. The actual value of air power, the Army and the Navy to a country might be stated as 50% for air power, 30% for the Army and 20% for the Navy. See how the appropriations are handled.

If the United States had a well organized air force, entirely independent of the Army and Navy, it would be completely immune from overseas attack. No ship could approach our coast across the Atlantic or Pacific Oceans in the face of a well organized air force. The air force is the only thing that can go up in the air and fight hostile aircraft. It is

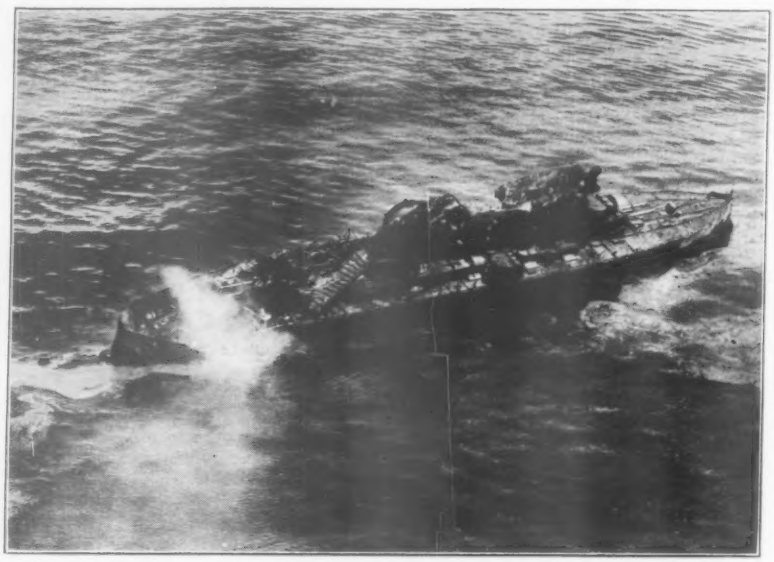
the only force that can launch an attack against a foreign country, either north or south of us, or across the Atlantic or Pacific.

The stepping stones across the Atlantic are not as far apart as most people think. Going by way of Labrador, Greenland, Iceland and Scandinavia, or the various islands north of Great Britain, the greatest sea hop is less than 700 miles.

In 1923, I conducted some maneuvers with what aircraft we had left and what airmen remained of the efficient war trained personnel, along the Atlantic coast, to show what could be done with even the primitive aircraft we had then. Having received authority from Congress to have two battleships placed off Cape Hatteras, to be used as targets, I landed our small air force of fifty or sixty airplanes on the island of Hatteras. This strip of land is a sandy fringe along the Atlantic Ocean. It lies 30 miles from the mainland, a distance which no cannon could reach effectively. It is protected to the north and south by deep inlets, Hatteras Inlet on the south and Oregon Inlet to the north, across which an army could not move in the face of the most rudimentary of aircraft. I landed 2,000 pound bombs, 1,100 pound bombs and 600 pound bombs, and all supplies necessary for the operation of these aircraft, from vessels in the water. This was to show that aircraft could be supplied by submarines, if they used an island and held control of the air. We also landed supplies from aircraft to show that we could be supplied through the air. In the old days, before the advent of aircraft, we used to think that a small island was a dangerous place to be caught, unless complete command of the sea were assured. But now aircraft can seize an island and operate from it without fear of interference by surface vessels, because they can sink them hundreds of miles away.

Submarines are the only seacraft to be feared and these are really a dangerous adversary, because they not only can rise to the surface and use guns of any size but they can launch aerial torpedoes and direct them by radio at objects on land. The best defense against submarines are other submarines and after that, aircraft. The only thing that could dislodge aircraft from a position of this kind would be a hostile air force. This of course would lead to an air combat for control of the air.

From our air base on Hatteras, we flew out over the sea and sank the battleships. One 1,100 pound bomb sank the New Jersey in 4½ minutes, tearing the whole top of it off. The other vessel was sunk in seven or eight minutes, after a decisive hit was registered. Some of our airplanes flew 179 miles to make the attack, which they launched from an altitude of 11,000 feet, securing around 60% of effective hits. The fire of great projectiles from aircraft is the most effective and the best directed fire we have ever known, as far as missile throwing weapons are concerned. It is more accurate than cannon or rifle fire.



The hulk of the New Jersey, showing the effect of an 1100-pound bomb. The ship sank four and a half minutes after this fatal bomb struck.

Having completed these tests and shown how an island could be used, I assembled our little air force the following day at Langley Field, Virginia, on the shores of Chesapeake Bay. The day following, I took these sixty ships (including some twenty-five of the logy old Martin Bombers) and flew from Chesapeake Bay to Bangor, Maine, landing in a field which we selected and which had never been used before by aircraft. This maneuver was executed not only to show how we could defend the whole coast of the United States from Maine to Florida in one day, but also to show how this same air force with which I landed at Bangor, Maine, in the summer of 1923, having flown in one day from Chesapeake Bay, a distance of 700 miles, could have kept right on and gone to Europe. By putting auxiliary gas tanks into these planes, which would have weighed no more than the bombs we carried, the radius of action would have been doubled.

Carrying out the same journey of 700 miles in the direction of Europe, we could have gone the first day from Bangor to Cape North in Labrador; the following day to Cape Farewell in Greenland; the day after to Iceland and the day after that to either the Scandinavian peninsula or the British Isles. With these old wartime aircraft, we could have gone right over to Europe! The following year, our Round the World flyers flew from Europe to America by the same short route. It is the one the ancient Norse mariners used when they went from Europe to America. With modern aircraft, this route can be used, islands seized and occupied as air bases easily. Airplanes capable of going 300 miles an hour can span this distance in a day.

An even closer bridge exists to Asia. There are only 52 miles of water separating Alaska from Siberia. It is along these lines that future invasions will come because they are the shortest lines and aircraft will fly direct along them, using comparatively small islands for their bases of operations and striking directly at the great vital centers, cities and transportation lines.

The United States is the most continuously self-contained country that the world has ever seen. In case of war, it can easily exist without ocean borne commerce. We raise everything that is absolutely essential to our maintenance and supply. Therefore, even if a Navy were effective as a means of controlling a sea, it would have comparatively little to do for us because we can very easily get along without it. Countries such as England or Japan are unalterably tied to their sea lanes of communication for existence. We in this country are the least tied to them of any nation on earth.

By this I do not mean that we should not develop our merchant marine to the greatest limits possible for the purpose of distributing our goods to the four

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corners of the earth. I am one who believes in direct government assistance to our merchant marine. But why should we pile money into a Navy which can bring us the least advantage of any of our three elements of defense, air, land and water, and leave an air force totally unprovided for, and the poor struggling air development tied to the tail of the Army, Navy and Commerce Departments? Do the Army and Navy give any consideration to the avenues of approach and attack by aircraft as I have outlined above, from Europe or Asia? They do not. These things were not done hundreds of years ago, they cannot find any precedence for them in their text books, and therefore what is the use of studying something that cannot be found in the pages of some old musty volume and then copied and modified a little bit to meet existing needs? In this day, constructive minds can employ the armed forces of a nation and bring about strategical results which would lead to world empire. If Germany had known the power of aircraft and the submarine at the beginning of the European War as they are known today, she certainly would have had world empire. All of this knowledge has come about in the last ten years. It is just as absurd to match an army and navy against air power as it was for the slow heavy-armored infantry of Europe to oppose the mounted horsemen of Genghis Khan the Tartar.

It is interesting in passing to note how Genghis Khan operated. To begin with, his men were inured to hardship. Their clothing consisted of sheepskins. If they were put to it, they could kill a sheep, take off the bloody skin, turn the wool in toward their bodies and sleep in a snow drift. Each man had three horses, riding one and leading two; usually these were mares in milk. They drank the milk and when they stopped, they would dry it and carry it with them. If pressed too severely, they killed a mare and ate the meat. By riding three animals, they could cover eighty miles a day. They always had their food and lodging with them and depended on no base of operations. They were armed with bows and steel arrows so powerful that they could pierce a corselet of the finest armor. Their men were divided into three categories: some carrying lances, using oxhide armor to protect themselves; others carrying swords, and others arrows of three kinds, one for killing animals, one for killing unarmed men and one for piercing armor. When they attacked the slow, sleepy armies of Europe, they were 6,000 miles from their base. The men with the spears and swords would engage the European men-at-arms in front, and as soon as they became thoroughly engaged in the combat, the main attack would be launched from behind them by the mounted men with their bows and arrows. This mounted fire action was always decisive and never on any field, no matter what the odds against them, was Genghis Khan ever defeated.

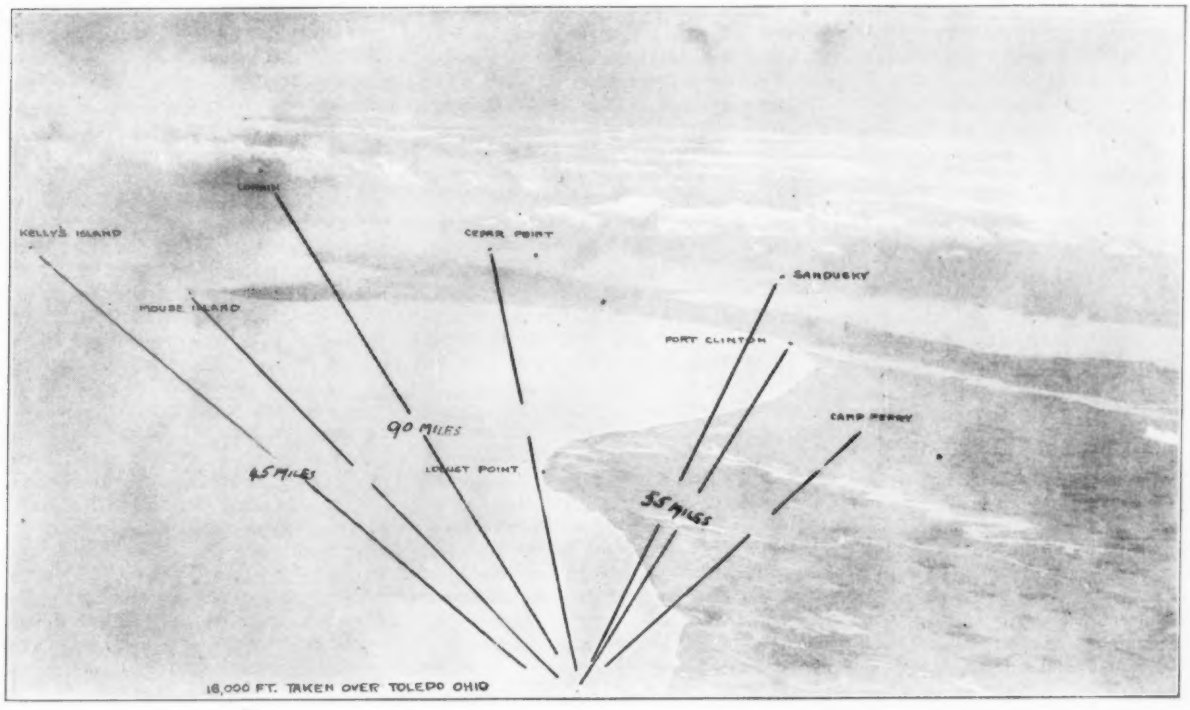
I attacked with my air force at St. Mihiel in much the same way. The Germans were confined to a salient, that is, an angle running into our position. I had 1,476 airplanes available for the combat. I so timed the attacks that several hundred would hit from the right side of the salient and then several hundred would hit from the left side. As soon as the combat became general, the main attack was launched by aircraft which had flown clear around both forces and attacked the enemy in the rear.

Future wars will see aircraft used in this manner, that is, the air attack will come from whichever direction offers the greatest advantage to the attacker. He has the whole air to operate in and to fly back in. He has the radio to use from ship to ship and he can communicate anywhere he desires. He can use the greatest weapons of all time and can bring about decisions in warfare with a speed never conceived of before. Once the power of initiative is seized by an air force, the opponent had better make peace.

All our old conceptions of navies and military strategy have to be changed, so great has the influence of air power become. It is a distinct move for the betterment of civilization.

(Another article by General Mitchell will appear in an early issue of Aeronautics.)

How ground and water looks from 18,000 feet altitude. Battleships can be distinguished at 100 miles in clear weather. (Taken from army airplane over Toledo.)



The Airplane

AN oil strike! A new territory, believed to be another source of the precious fluid, is discovered in some remote mountain region. In the office of the great producing company, hurried conferences are held; typewriters chatter, office boys scurry in and out summoning officials. Who knows anything about this district? What is the likelihood of securing leases? What other companies are already there? What is the general rock formation? How far down will the drillers have to sink their wells? Boy, tell the Chief Geologist to come in here.

The Chief Geologist takes the situation quite calmly. He's been through the same thing before, and tells the directors that he can give them a good appraisal of the area in a very short time. While the slow-moving competitors are assembling and equipping their surveying and geological expeditions, he can furnish the whole preliminary study of the entire area, and mark the spots where oil is likely to be found.

Not one man will have to set foot on the territory, or dicker with suspicious landholders for permission to examine their holdings. Nobody will know that the company is investigating the scene.

How can all this be done? By using the modern airplane, and its valuable partner, the aerial camera.

Aerial surveys for oil purposes began to influence the petroleum producing industry in the latter part of 1927, and in the brief period since then have done peculiar things to the habits of petroleum geologists. Practically all of the major companies of the south and west now use the aerial method as a standard means of gathering information, and one company has already mapped four different areas from the air.

No longer does the geologist saddle his mule and go forth to spend many weary weeks in solitude, splashing through swamps and fighting his slow and painful way over towering mountain peaks. No longer is it necessary for him to wander hither and yon, hoping to find some clue which will support a theory of subsurface oil deposits. Formerly he spent ninety per cent of his time merely looking. Now he goes and gets.

The aerial pictures which have been furnished him beforehand show him the natural formation and layout of all the features in the district. If he makes a field study at all, he knows where the geological formations he desires to study are located, and if they disappear suddenly into the bosom of mother earth, these pictures help him visualize their subterranean appearance and direction.

When the first oil surveys from the air began to cause anxiety among the companies which up to that time had failed to appreciate their advantages, the officials of these companies began to ask themselves what sort of a freak invention the aerial map was, anyhow, that it could revolutionize such a classic and time-honored profession as oil field geology, almost overnight. The more progressive of them lost no time investigating the status of aerial mapping, and found that an oil map is like any other aerial map, and possesses the same advantages which are found in almost every example of the flying camera wielder's art, namely, amazing speed, accuracy of information, low cost per mile, and the thousands of bits of information which do not appear on a standard line-drawn map.

This much is enough to revolutionize any sort of a map-making problem, but in addition, the oil map has one advantage which definitely overshadows every sort of a map made by ground methods. The aerial oil survey is made from an average height of about three miles. At that altitude a property owner can't even see the airplane containing the camera. It's only human nature to boost values sky-high if the owner thinks his property contains oil, or merely if a representative of an oil company asks him for permission to examine the geological features of his land. If the company subsequently desires to lease a portion of it, the price demanded is usually out of all reason, and even with astute bargaining the company has to pay a great deal more than if the owner had no previous knowledge of the company's intentions.

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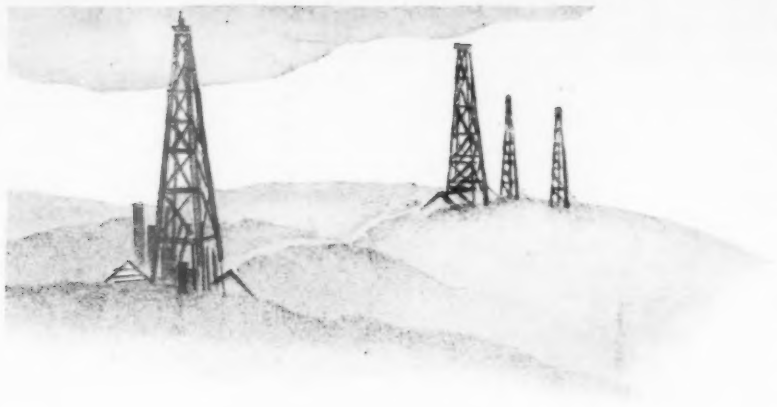


Finds Oil

By Kent Sagendorph

The manner of preparing an aerial geological oil survey differs somewhat from that employed in some forms of aerial mapping. Oil surveys are usually made from an extreme altitude, often in the neighborhood of 18,000 feet, because at that height each 7x9 inch photograph covers an area of approximately two miles by two and a half miles, or five square miles, at a scale of approximately one inch to 1,500 feet.

The cutting and fitting in the laboratory, together with the necessary allowance for overlap, reduce the effective area of each exposure to about one square mile, and these pictures are carefully fitted together and built up into a photographic map.

Another important asset of the aerial photographic survey is this: the cost of the survey can be made to fit in with the importance of the project to be studied. If the producing company merely wishes to gain some general information concerning the geological formation of a certain area, and it is only necessary to trace some particular rock strata or drainage system, the chief geologist can assemble the loose prints on his desk and point out to his field crew exactly which parts they are to examine.

This not only eliminates all the lost time prospecting in territory which has no geological value, but also enables the chief geologist to give these same prints to his men to take into the field with them, with clear instructions as to just how to proceed.

However, the chief geologist often requires a great deal of accurate, scaled information, both geological and physical, such as a map of an area into which the company is planning to rush an advance party and start drilling operations at once. In cases like this, the aerial photographic survey proves its manifold advantages, and dominates the scene like a lighthouse.

If the area has had a preliminary survey and the company decides to start drilling, the same pictures which have been used by the field crew can be built up into a precise map, with no duplication of time or effort, and returned to the chief geologist in any convenient size, showing every single square inch of the entire area in its exact relationship with every other square inch, all the geological features clearly in view and the general topography of the country plainly indicated by shadows, or other means.

This subject of topography is one of the geologist's chief problems. In the past he has been forced to send out both surveying crews and expert topographers, who traced the contours of the various hills and valleys and made a contour map, full of little crescent-shaped markings and mysterious wavy lines, designed to show how high a certain hill, or group of them, was above the adjacent valley.

These men are all highly trained and long experienced, and the average cost of a "Plane-table" party, as they are called, runs about $1,000.00 a month, besides consuming weeks of precious time. Once again the aerial camera came to the chief geologist's aid and provided an instrument known as an aerial stereoscope, by means of which a set of prints could be studied in relief right on the chief geologist's desk; just as if a perfect three-dimensional plaster model, showing every hill, valley, tree, road and rock formation were there before him.

This bright idea is, in reality, only a variation of the famous post-card stereoscopes of the Victorian era, by means of which our uncles and grandfathers whiled away the long winter evenings, reclining on their horsehair sofas looking at pictures of Niagara Falls, and so forth.

By means of this device, the geologist can calculate what the conditions of the geological strata are, by comparison with the topographical condition of the ground. If there is any evidence on the ground which helps to locate a geological point, it can not only be worked out more quickly by means of the aerial method, but frequently there is no other method of determining it.

For instance, in California a definite slope of a rock ledge suddenly disappeared into a flat, uncultivated valley where all trace of it was lost to ground investigators. It was plainly traced in the aerial pictures, however, and followed four miles out into the valley, and the angle of decline was projected this same distance, much to the relief of the geologist in charge of the work.

In hundreds of cases where all surface indications are lost, the aerial views will show the geological formations beyond question. A contact between formations, for example, has been traced in spite of a standing field of grain three feet high.

An example of subsurface formations appearing in aerial pictures is contained in illustration No. 1. This is a vertical view of the St. Francis dam disaster, in California, taken soon after the structure had given way and flooded the

country for miles around, causing immense property damage. A fragment of the destroyed dam is seen in the left center of the picture, with a wide gap between it and the remains of the wall, shown on the right. In the center of the picture, and in the center of this gap, there is a line, and notice the difference in color between the soil on either side of this line. This indicates an important subsurface condition known as a "fault," but this line would be practically invisible on the ground and the difference in color would not be noticeable enough to attract attention. From the air, however, these differences are seen at a glance. Differences in color of either soil or vegetation, while remaining unnoticed to the ground observer, indicate to the aerial camera the character of the subsurface formation.

A vertical aerial photograph has always been a sort of puzzle to those who look at it for the first time. The story it tells is so different from that to which the eye has become accustomed that some practice is usually necessary before the picture can be induced to give up its secrets. You can turn it around, or upside down and there appears to be no top or bottom to it—no starting point, in other words. Now, there is a way to do everything, and there is only one simple rule to follow when examining an aerial photograph. Namely, i. e., and to wit: turn it so the shadows point down. The reason is that the human eye never sees any shadows on the far side of the objects causing them, for the simple reason that the object hides its own shadow. But with all the shadows pointing toward you, or downward, the object is on the far side of the shadow, and the proper sense of relief is at once established.

In illustration No. 2, we see an example of this phenomenon. This is a vertical view of an orchard district in California and was taken in the winter, but largely on account of the efforts of the Los Angeles Chamber of Commerce there is no general evidence of it, and most of the trees obligingly posed for the picture in full leaf. This gives a good idea of the immense amount of territory covered by a single exposure and the wealth of detail which is so unerringly recorded, in spite of the rather extreme altitude of 16,000 feet. There are five groups of ranch buildings, thirteen orchards, two roads, a mountain range and a river. On the lower side of the picture below the hills there are three more orchards and another group of buildings.

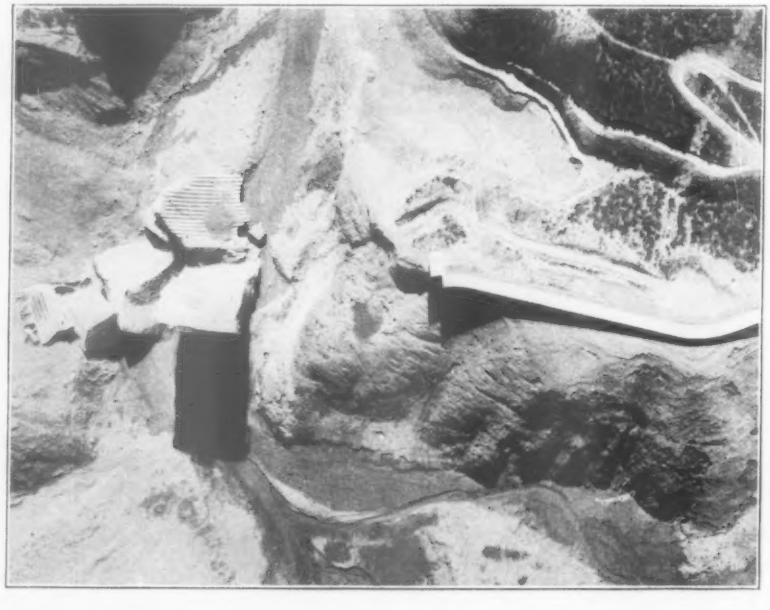
About one-third up from the bottom there is a series of four dark patches, running transversely across the picture, indicated by arrows. This indicates a gigantic fracture of the rock strata composing the hills, and runs for miles across the country. In an aerial picture, especially from this altitude, the geologist can grasp the whole situation at a glance, and is spared the monotonous task of prospecting over the tops of these hills on foot, with the risk of passing such important finds unnoticed.

Aerial maps are being used to such an extent by geologists and other departments of the oil producing industry that there have been different applications of them by different companies. Of course, varying degrees of accuracy are required to suit various conditions, but in general, three of the methods used might be taken as standard. First, there is the group who feel that the extreme accuracy of the finished aerial photographic map is not justified by the limited use which they intend to make of it—as a map. They merely wish to assemble the corrected prints as nearly as possible into a "rough" mosaic, which looks all right, and shows them the features they seek, so the extra effort of corrections in scale is not justified. A map of this kind might carry errors in scale all the way from nothing to twelve or fifteen per cent, and might, and often does, prove woefully inaccurate for precision work. These men feel, however, that even though it is a little distorted the distortion is probably not abrupt, and the general relationship is correct enough for their purposes.

Sometimes the aerial photographs are used loose; without any mosaic or assembly of any kind. The geologists who are in the habit of employing this method are generally those who find difficulty in accustoming themselves to any sort of a map except an old-style line map, and who provide themselves with some sort of ground network to aid them in using their aerial information. This may be either an actual survey, or the use of known points obtained from another map, all of which is transferred to a new drawing. As the geologist proceeds with his work, the information he derives from the aerial photographs is plotted in on this new map. This is expensive and cumbersome, but the map which finally emerges is a line map and one exactly like the ones the geologist has been in the habit of using.

However, most of the profession have adopted the practice of building up their geological map over a photographic one. This is done by assembling all the information brought in by the field geologists and drawing it in ink on the photographic map. The result is the present day method of assuring absolute accuracy and easy interpretation of the complex data pertaining to the discovery and location of petroleum.

In the center of the gap in the destroyed dam can be seen a difference in surface coloration. This shows a subsurface "fault," invisible from the ground.



Now, geologists require a good deal of service from the concern which makes their aerial pictures. First and foremost the aerial photographic company must be one which has the resources and equipment to properly execute a job of this kind, and believe me, gentle reader, it requires quite considerable execution. Oil fields, especially the newer areas, are more liable than not to be discovered in some such locality as the Isthmus of Tehuantepec, or the Bay of Whales, or the borderline between

(Continued on page 90)

Airports vs. Landing Fields

By Lieutenant Commander James M. Shoemaker, U. S. Navy

THE growth of the aeronautical industry, and of the so-called "air-mindedness" of the United States, can be measured not only by the number of airplanes sold, but also in terms of the number and quality of American airports. Aviation enthusiasts the country over have been persuaded, or have persuaded themselves, that what their home city needs is a "bigger and better" airport. Promoters can make a tract of land which they are trying to sell seem an ideal airport site. All that is required, so they say, is that the land be reasonably level, and large enough to provide two (or more) long runways. And if such an area, developed or not, is close to the center of the city, the more weight and force their arguments acquire.

It is quite true that such a tract of land, with crossed runways to permit airplanes to land into or nearly into a wind from any direction, makes an excellent airplane *landing field*. Other considerations than these, however, must enter into the choice of an *airport* site. Even nearness to the center of the city, with consequent lessening of the problem of hauling passengers and goods to and from the airport, is not by any means sufficient reason for the choice of an airport location which is, or can be made, otherwise suitable as to landing areas. An airport site must be chosen not only with regard to its level acreage and nearness to population, but with particular regard to the character of the adjacent land, and to local aerological conditions.

Forced landings just after taking off in an airplane, while becoming rarer and rarer with improvements in material, can never be entirely discounted. An airport that is surrounded by high buildings, or situated in the midst of a swamp, will sooner or later take its toll of human lives as a consequence. As an example, Prospect Park in Brooklyn has every advantage of terrain, proximity to a center of population, and ease of transportation from airport to city. In spite of all these, the presence on every side of tall buildings and thickly populated areas makes Prospect Park totally unsuitable as a possible airport. Tall buildings adjacent to an airport carry with them another great disadvantage. They cause powerful up currents and down drafts in the air together with swirls and eddies in the streets between the buildings, and these factors add vastly to the dangers of the low-altitude flying required when approaching and leaving the airport.

General flying conditions vary greatly in localities which are sometimes almost contiguous. They are affected by the elevation of the flying field, its distance from a large body of water, and particularly with its direction from the city with respect to the prevailing wind. An airport located on low ground near a body of water will suffer from morning mists that frequently prevent flying until the sun has burned the mist off. Airports located near a large body of water are often affected by fog which, in the morning, causes zero visibility on the ground, and later in the day rises from the ground to form an impenetrable layer only a few hundred feet from the earth. The most favorably situated seacoast airport I have ever seen is the government field at North Island, San Diego, California. Here the prevailing wind is from the northwest, often bringing fog down the coast with it. But North Island is protected to windward by the high peninsula of Point Loma, and though day after day finds the whole coast of the north and south fogbound, and fog rolls in great billows over Point Loma itself, yet North Island and San Diego Bay have perfect visibility, where California sunshine is unbaffled by fog.

Smoke in the neighborhood of large industrial centers is just as inimical to good visibility as is fog. Flying from Washington to New York on a clear day

with a moderate northwest wind blowing, one realizes just what a menace smoke would be to airports located to the southeast (down wind) of the big cities. The airway route lies to the southward of the factory areas, and in the vicinity of Baltimore, Wilmington, Chester, Philadelphia, Trenton, and the Metropolitan District, the smoke pall turns sunshine into semi-darkness, and lowers visibility to nearly nothing.

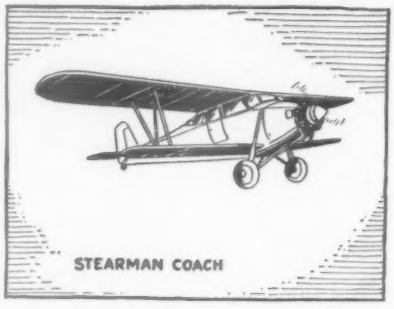
So many requirements for an ideal airport have been pointed out that the reader may well have gained the impression that there can be no good airport near a large city. The author must confess that most of his flying has been conducted from government fields, so he has had occasion to use few municipal airports. Nevertheless, one large airport in the Middle West stands out in my memory—the Chicago Municipal Airport. It suffers from the one disadvantage of distance from the Loop, but other than that it is nearly perfect. Wide cinder runways laid out in the form of the British Union Jack; excellent approaches from all directions, with danger from a forced landing near the field minimized by the level terrain and few high buildings; and with far better average flying weather than Chicago proper, the airport on Cicero Avenue is one among many.

The City of Chicago already appreciates the disadvantage of an airport which is some miles distant from the center of the city. Chicago's solution has been to plan and start construction of an airport on the lake front, as close as possible to the center of the business district. This airport, as I understand it, will be auxiliary to the present municipal airport as regards landplane traffic, but will be the seaplane terminus. The lakefront airport will handle passengers and mail to and from the municipal airport, but will be closed to other air traffic except seaplanes, thus avoiding the dangers incident to low altitude operation of airplanes over thickly populated areas.

A possible solution to the air passenger terminus problem is the development of seaplane bases for this purpose. Then the air traffic to and from the main airport can be handled by amphibian airplanes, which will operate as landplanes at the airport, and as seaplanes at the passenger terminus. The construction of seaplane bases involves only a small percentage of the expense of airport construction, as the landing area needs no preparation. Because seaplane bases cost so little to install, it will be possible to provide two or more of these, so located that one of them will be at all times to windward of the city, and hence clear of smoke. Reference to an atlas will show that all of the large cities of the country are situated on bodies of water which can be used for seaplanes.

In addition to organized airports and seaplane bases, there is a great need in commercial aviation for emergency landing fields along the established airways. These landing fields should be provided at intervals of ten to twenty-five miles, depending on the availability of level ground, and on the suitability of the terrain for emergency landings. In the Middle West, for instance, landings can be made in almost every large field. On the other hand, mountainous or rolling country offers few natural landing areas, and the need for prepared emergency landing fields is great.

Emergency landing fields need not be square or L-shaped. One long runway, laid out in the direction of the prevailing wind, should be quite sufficient. This will enable into-the-wind landings to be made in either of two directions. Emergency cross-wind landings can be made at any time. Emergency landing fields


STEARMAN COACH

exist at the present time along most of the established airways, and are so marked on the airway maps, but they are deficient as to the character of night-lighting provided for them.

The airway beacon at an emergency field should be so located and arranged that the pilot flying at night or in thick weather can know just where the field is to be found. This can be achieved by placing a revolving beacon in the center of a long side of the field, with a fixed beam of light from the beacon directed across the field. Then the night-flying pilot will know that if he "sets her down" near the beacon and on the side pointed out by the fixed beam, everything will be "hotsy-totsy." The mounting of a wind-cone (or "sock") in the path of the fixed beam from the beacon will prevent downwind landings, with their possibilities of disaster.

The subject of airport lighting is still an open one. There are two distinct schools of thought, one maintaining that airports should have landing lights as well as boundary lights, and the other school insisting that airports should be dark except for the boundary lights, and that the landing lights should be carried on the airplanes themselves. No definite trend of opinion toward one or the other school has been noted, but several phases of the question are interesting.

In the first place, the use of airport floodlights, and the elimination of landing lights on the airplanes, would improve airplane performance due to the reduction in weight and drag. In the second place, duplication of the field lighting installation, and an emergency source of electric power, can be provided at the airports, while such duplication cannot be made on the airplanes. Opposed to these arguments for the use of airport floodlights rather than airplane landing lights is the fact that night landings away from a lighted airport necessitate landing lights on the airplane. And since landing lights for emergency use must be provided on all night flying airplanes, why not use these lights all the time?

Landing lights are practically useless on seaplanes, because the beams of light striking the water ahead of the plane are refracted rather than reflected, making it impossible for the pilot to judge his height above the water. Floodlights located close to the surface of the water are very satisfactory for use in the lighting of seaplane landing areas. For emergency night landings on the water, the author has found that aircraft floatlights are ideal. These floatlights ignite and burn for several minutes on the water. For use in night landings they are dropped in a row at short intervals (three lights is sufficient) while flying downwind. The plane is then turned into the wind and landed toward the row of floatlights, which give a perfect indication of the surface of the water.

The question of the proper material for airport runways is also unsettled. Various authorities recommend sod, cinders, rotten stone, concrete, and other materials. The choice among these is probably best made on the basis of their relative cost and availability, although sod has the drawback of being easily cut up by planes equipped with tail skids instead of tail wheels. The principal consideration (aside from size) in runway construction should be that they are well drained and that they are free from dust or sand. Emergency landing fields call for little surface preparation. Well-drained sod is excellent, and it should need no care except to keep the grass not more than a foot high.

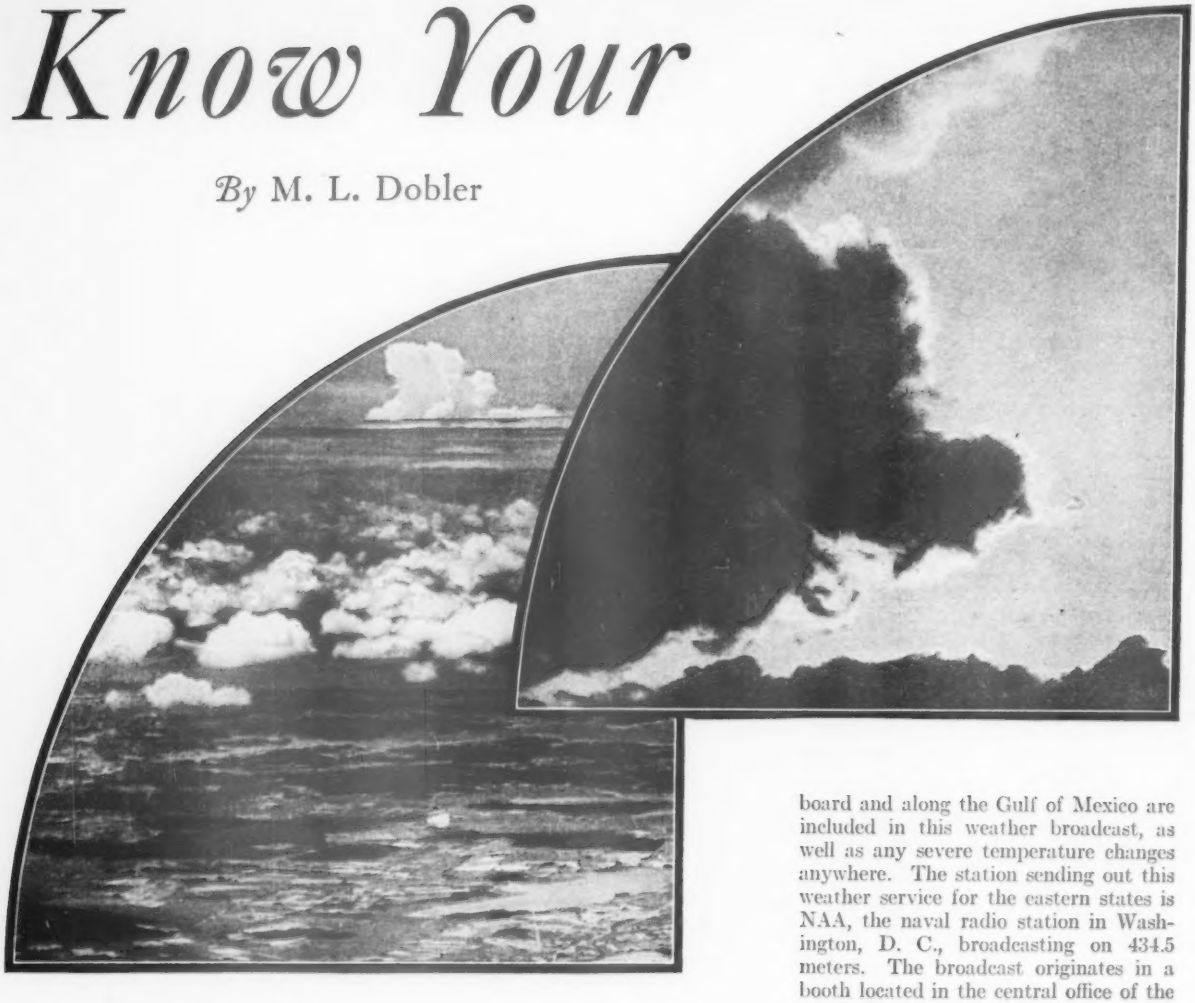
The design and construction of airports has lately developed into a distinct profession. Many are the firms that advertise themselves as Airport Engineers, and the list is growing rapidly. Airport engineering properly includes the selection of the site as well as the layout and construction of the landing area and the buildings. Certainly the choice of the airport site is at least as important as its actual construction. But it is feared that political considerations, apart from those enumerated as desirable in this article, control the selection of many sites.

XUM

MISS MARJORIE CRAWFORD with King Bee at Santa Barbara. She is now preparing to challenge the Woman's Flight Endurance Record at Los Angeles. Miss Crawford is the only woman considered eligible for handicap by the National Polo Association.

Know Your

By M. L. Dobler



INASMUCH as the weather plays such a conspicuous part in making flying good or bad, or safe or dangerous, it is highly desirable for us to acquaint ourselves with the mysteries of the weather map so that we can intelligently decide among all sorts of weather conditions just which are best suited to our needs.

Accurate and detailed knowledge of weather conditions not only at the surface of the earth but likewise at different flying elevations was one of the chief factors contributing to Colonel Lindbergh's success in his flight to Paris, and it is equally vital to the success of any flight. An idea of weather conditions obtaining in the area in which we propose to fly is not difficult to secure. Inquiry at our local airport or at the nearest weather bureau office will elicit all possible information, and will insure that we make the most of whatever opportunities for good flying conditions the sky may offer us.

The spring and the fall are ordinarily the best times of the year for flying because it is during these seasons that the aviator is most likely to be near an area of high pressure, indicated by a high reading on the barometer. Let us imagine that we are to fly from Curtiss Field, Long Island, southwest to the valley of Virginia. Let us further imagine that we are hoping to take off on the morning of February 15th. We will need to consult the weather map showing general meteorologic conditions throughout the United States, at 8. P. M. February 14th.

At this point mention should perhaps be made of the fact, certainly familiar to most of the readers of this magazine, that practically all of us have access to the latest data concerning flying weather through our home radio sets. We in the East may tune in any morning or evening at five minutes past ten and for ten minutes listen to forecasts for all states east of the Mississippi River, and a general summary giving the locations of centers of high and low air pressures over the United States and Canada. Wind conditions on the Atlantic Seaboard and along the Gulf of Mexico are included in this weather broadcast, as well as any severe temperature changes anywhere. The station sending out this weather service for the eastern states is NAA, the naval radio station in Washington, D. C., broadcasting on 434.5 meters. The broadcast originates in a booth located in the central office of the U. S. Weather Bureau.

Flying weather conditions in the middle west are broadcast every hour over radio station WGN. No section of the country is without some accurate service of this kind.

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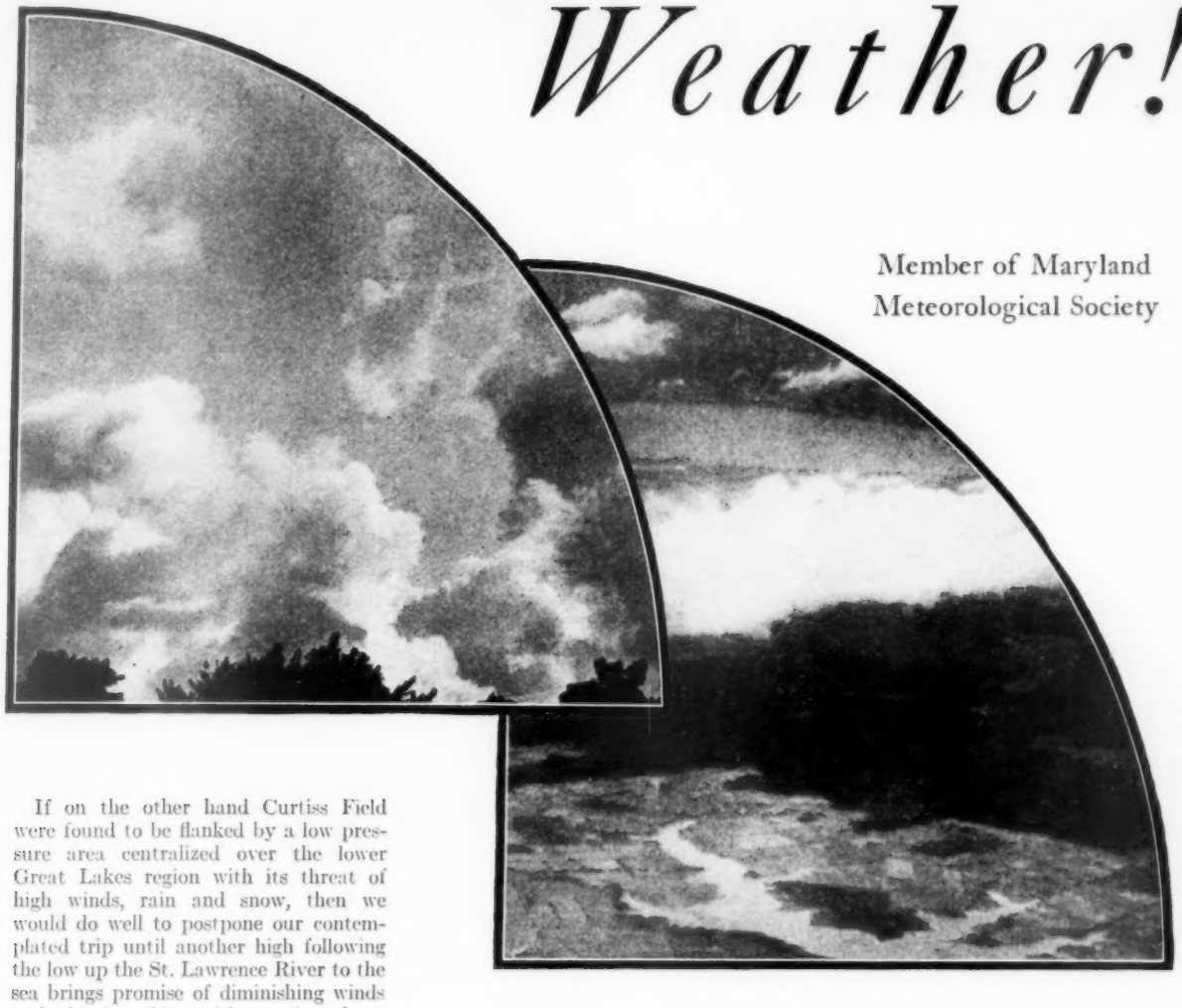
The slight low area moving northeast at a considerable distance off the coast line is of very minor importance and will not need to affect our plans very much. The absence of steep pressure gradients insures for us freedom from any very heavy wind out of the southwest or west aloft, and gives us the right to expect light variable winds at the surface. Conditions are favorable for our flight to Virginia.

XUM

Weather!

Member of Maryland
Meteorological Society



If on the other hand Curtiss Field were found to be flanked by a low pressure area centralized over the lower Great Lakes region with its threat of high winds, rain and snow, then we would do well to postpone our contemplated trip until another high following the low up the St. Lawrence River to the sea brings promise of diminishing winds and clearing skies with a crisp sharp horizon through the water-washed air.

During the summer time heat currents with cold northwest winds at five thousand or ten thousand feet levels often give rise to local line squalls or thunder storms, even though the low area itself may not be very well defined. These squalls are likely to occur in mountainous districts, such as the Adirondacks, the Green Mountains, the White Mountains, and particularly the mountain districts of the Shenandoah Valley of Virginia.

Line squalls and thunder storms develop rapidly in the spring and summer over much of the route from Chicago to Cleveland and from Cleveland to the east.

Too much stress cannot be laid on the primary causes which produce low ceilings and fog, particularly in the Allegheny and Blue Ridge Mountains of Virginia, West Virginia and Pennsylvania. There are times after a period of rainfall when even under the influence of a high barometer, rapid night radiation will form mountain clouds and fog that reach their maximum intensity at about dawn before the sun's heat has had a chance to absorb them. Most dangerous of all types of low areas is a barometric depression advancing slowly northeastward over the Tennessee Mountains or the Smoky Mountains of western North Carolina, carrying light east and southeast winds at the surface and somewhat fresher easterly winds at one thousand to five thousand feet altitude. These sorts of low should be carefully watched by all pilots as it is likely to produce extremely bad flying conditions.

The writer has for many years made a special study of line squalls over the Shenandoah Valley of Virginia and Harper's Ferry to the northeast and Staunton and Lexington to the southwest, the trend of this great valley being in these directions, and it appears that the squall-front strikes these mountains as a rule about one P. M., reaching Washington, Baltimore and New York from an hour and a half to four hours later. In other words, these squalls seem to find their origin further west, in the West Virginia mountains, between eleven o'clock in the morning and high noon, at the time of day during the spring and summer when the heating of the air and the development of convection currents begins to be most pronounced and cumulous clouds begin to form.

Thunder storms in themselves when purely local affairs are not marked by the severe characteristics common to line squalls with their attendant steep temperature gradients to the rear of the Northeast-southwest axis of the trough of low pressure as it swings eastward across the Ohio Valley and middle Atlantic states. A trough of low pressure extending in a southwesterly direction from Quebec or Ontario into Illinois or Kansas with a high area of some magnitude over Manitoba or Minnesota indicates a somewhat unpromising condition for the cross country pilot, particularly if he is in the vicinity of the treacherous Alleghenies. This trough is very likely to swing east or northeast, across the upper middle west and beyond through Indiana, Ohio and Pennsylvania,

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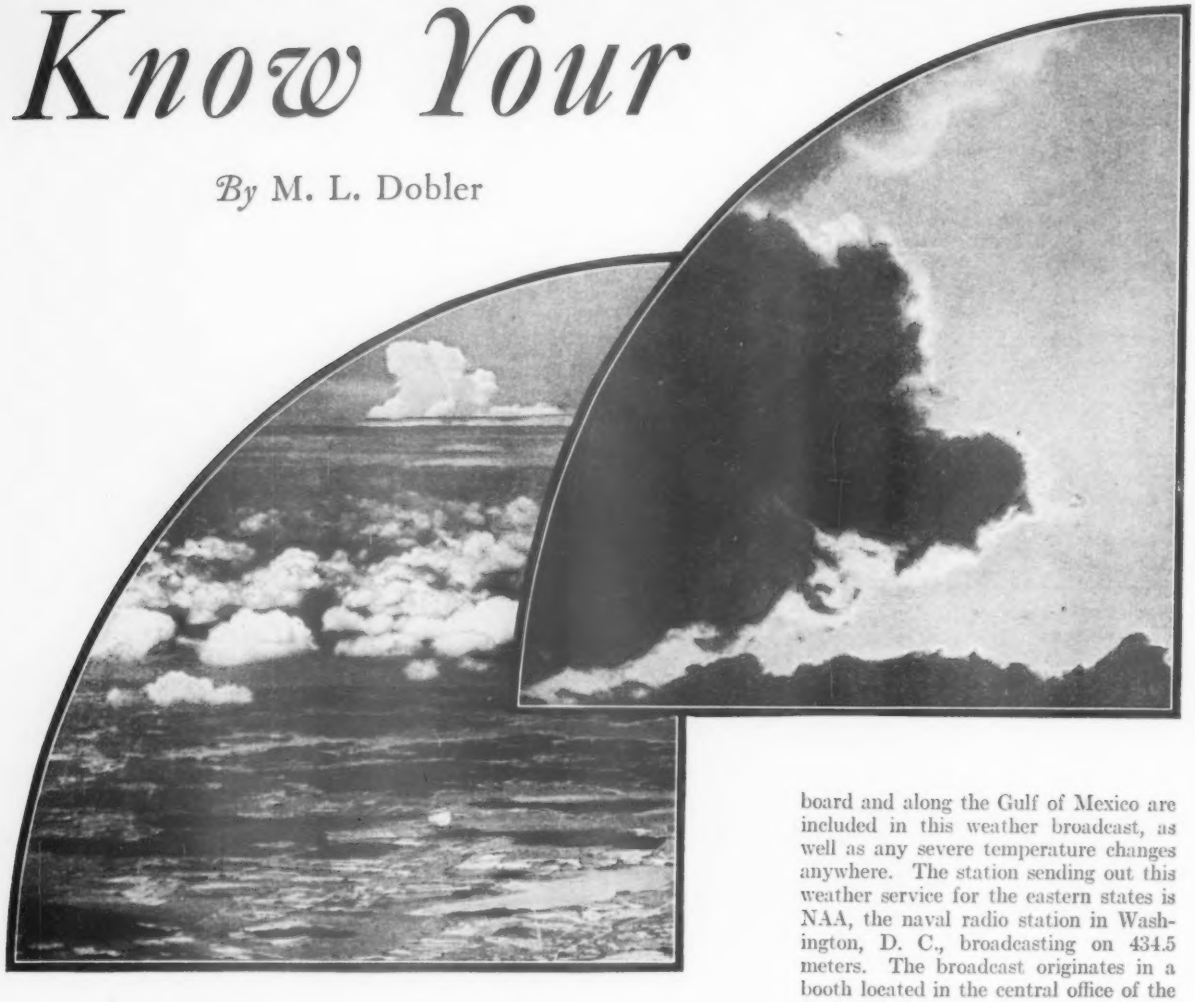
By M. L. Dobler



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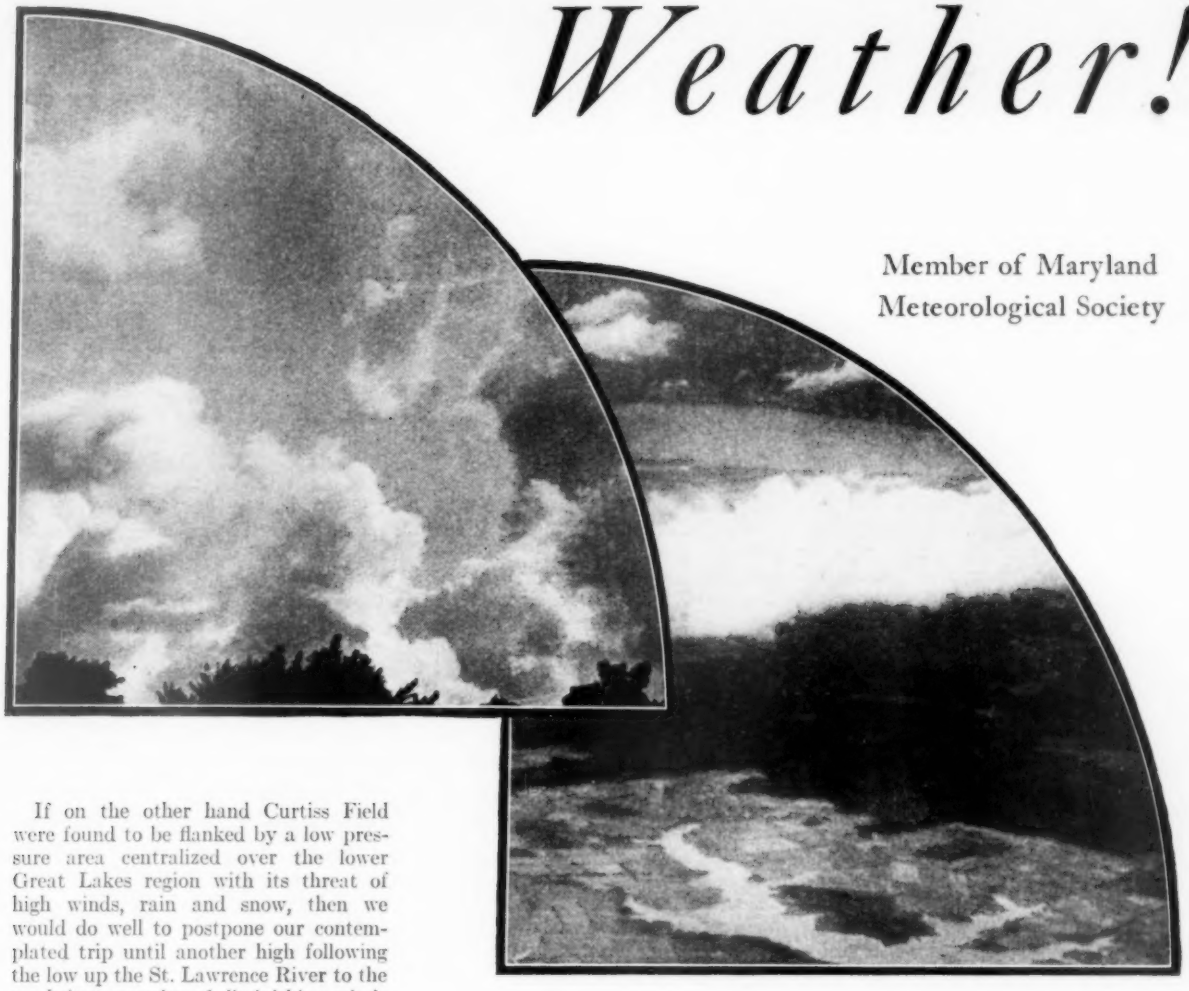

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bringing with it a low ceiling, fog banks and rain clouds, as well as the line squalls just described.

It is scarcely necessary to point out the fact that in addition to the bad visibility and electrical menace which result from squalls they produce, particularly over mountainous terrain and on a hot day very turbulent air with its accompanying tendency to toss the plane about in violent lurches and "bumps."

Mountains, of course, have certain rather well defined tendencies of their own in producing interesting flying weather. Captain Richard Duncan in his well known manual on Air Navigation and Meteorology has this to say concerning mountain and valley winds:

"Mountain and valley winds occur in mountainous regions in relatively quiet conditions of the air. There is then, especially in clear weather, an upward motion from the valleys during the day, and a downward motion towards the valleys at night. These winds have some analogy to the Land and Sea breezes.

"In the night the cold, denser air descends from the mountain tops, which cools very rapidly by radiation, toward the valleys below. These downward currents commence first in the narrow valleys on the mountain side, in which the air is heated during the day; but the descent soon becomes general, and the air flows down to wider valleys below. In the morning the air over lower levels of the ground becomes heated, and the surfaces of equal air pressure over those levels at some little distance away from the mountain are elevated, but directly on the mountain they are not, because there is no air below to expand upward; so that the air flows down these north horizontal surfaces towards the upper parts of the mountain, which it strikes at such an angle as to deflect it upward along the mountain side. In addition to this motion, there is an upward motion along the mountain side, due to the action of the sun's rays in the warming of the ground along the slope and the air immediately above it; so that the upward motion of the air along the surface of the ground is the result of these two motions combined. The accumulation of this air at the top of the mountain is prevented by horizontal currents which exist there."

It has been the writer's observation that about the meanest low ceilings one is likely to encounter in mountainous territory occur between the Blue Ridge range to the east and the Allegheny ranges to the west when a secondary or at first uncharted low is forming over Tennessee or the extreme southwest end of Virginia near Wytheville and Roanoke.

While the upper cloud levels at an altitude of a mile or more may be moving southwest the lower cloud levels are rapidly closing in from the southeast across the ranges, and a very slow moving low of this description can produce bad flying weather in these mountains for from two to three days at a time.

Another condition likely to produce low ceilings in the mountains during the spring and fall is the familiar "northeaster," which when fully developed with a center pressure reading of perhaps 29.60 inches over Knoxville, and with a tendency to move northeast up through the Shenandoah valley, produces a strong draft at the surface with low scudding cumulo-nimbus and nimbus rain clouds flying with the surface wind. This is most annoying to the pilot navigating these mountain regions.

A trough of low pressure extending from New York state to Asheville, North Carolina, but moving rather slowly out to sea with a high barometer area of some strength building up in the Ohio valley and Great Lakes districts, often causes, it must be remembered, northwest winds and continued rain and snow at elevations of 1500 feet and over for from 24 to 36 hours longer than it does in adjacent cities and towns of the lowlands and the Piedmont section. These latter points will experience merely overcast skies of cumulo-nimbus and stratocumulus clouds at rather high ceilings of from two to three thousand feet or more. It is not difficult to understand why towns on top of the Blue Ridge in Virginia and Pennsylvania during late fall or early spring have rather heavy snowfall while Pittsburgh, Harrisburg, Baltimore, Washington and Richmond may be simply experiencing rain-showers.

Certain general tendencies in the development of weather conditions based on a few fundamental meteorological facts go a long way toward explaining the routine behavior of winds and clouds, and it is well occasionally to remind ourselves of these matters.

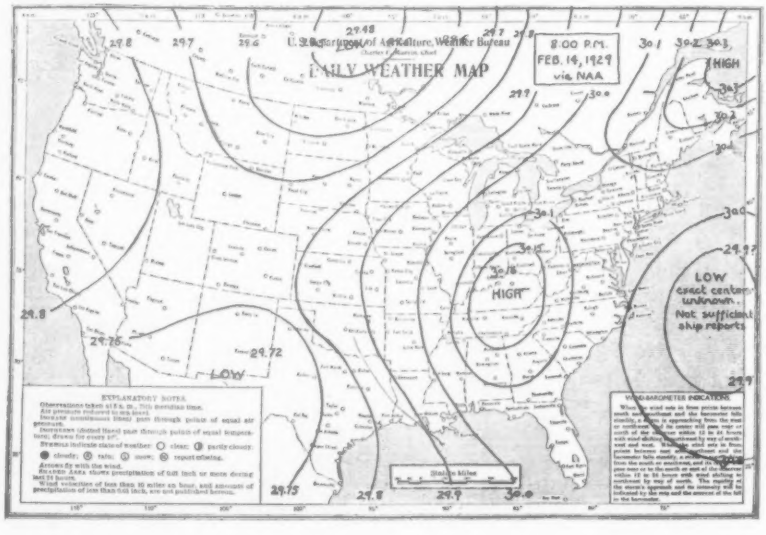
Wind is heated at the equator and tends to flow upward, producing a low pressure area, characterized by calms and rains. But some 30° north and south of the equator there are belts of high pressure, with air flowing both back towards the equator and out towards the poles. Because of the west-to-east rotation of the earth these north and south winds are deflected, to the right (east) in the Northern Hemisphere, and to the left (east) in the Southern Hemisphere. Thus, northeast and southeast trade winds prevail near the equator, while in the more temperate latitudes of the Northern Hemisphere southwest winds blow, with corresponding northwest winds in the temperate zone of the Southern Hemisphere. In the main this is the world-wide wind scheme, though it is subject to many less definite influences.

Along sea-coasts the usual program for the wind is extremely simple. During the day the land becomes heated and low pressure follows with a breeze blowing in from the water. At night, owing to the fact that the land loses its accumulated heat more quickly than the sea does, a colder high pressure area is produced, with the land wind blowing out to sea until morning.

Captain Duncan calls attention to several useful meteorological facts which he has reduced to averages. Low pressure areas move at an average speed of 27 to 28 miles per hour. High pressure areas

(Continued on page 81)

The author shows the significance of the highs and lows in flying terms.



Large Scale Operations of Ten-Passenger Airplanes

By Archibald Black[1] and George F. Wheeler[2]

IN the preceding article we considered the operations of 5-passenger airplanes and showed how the cost per passenger mile dropped as operations increased. The largest scale of operations considered in this first study provided for a total of 40 passengers each way daily. However, traffic attaining this rate would assuredly make it advisable to substitute large capacity airplanes. Hence we will now consider a similar route but operated with 10-passenger ships instead. In this case the New York-Cleveland route is assumed to be scheduled for operation as nearly as possible 7 days per week or 365 days per year. This, of course, is subject to reduction in practice due to weather interference, as explained in the previous article, as will be considered again hereinafter. The 10-passenger airplane is now assumed to be used as a trimotored ship with the three engines totaling 675 horsepower. In this case the crew of each airplane consists of a pilot and an assistant pilot or a pilot-mechanic. Dual controls would be provided and the pilots seated side-by-side so that the ship could be flown by either of them. In the ordinary course of events the pilot in charge of the ship would control it. However, he would be relieved from time to time, as occasion warranted, by the assistant seated beside him. Also in case of sickness, the assistant would take over control.

This is the second of a series of three articles prepared especially for Aeronautics by Archibald Black and George F. Wheeler of Black & Bigelow, Inc. The other article will be published shortly and will deal with large scale operations of eighteen passenger planes.

Advantages of Trimotor Ships

This combination of a trimotored ship with two pilots and a dual control system would increase the safety and reliability of the operation. It should also have an effect upon insurance and tend to reduce premiums on certain classes of coverage but no allowance for this has been made in the estimates. For a passenger route operation of this character, the trimotor airplane has many important advantages. Where other conditions permit preference should be given to this type in selecting airplanes for the purpose. Not only does the trimotor type possess the advantages of additional safety and regularity, but the public is sufficiently educated to realize this. As a consequence, the prospective passenger greatly prefers to fly in trimotor ships. Any decrease in sales resistance both increases traffic and lowers the selling cost, hence no point of this kind should be ignored. Just as with the single-engined ships considered in the first series of estimates no intermediate stop is scheduled, although provision is made for a stop at Bellefonte in emergencies such as "thick" weather.

Scheduled Operations

Again, as mentioned in the previous article, the air route distance is about 395 miles. The same scheduled speed of 100 miles per hour has been assumed. This is amply conservative as trimotor ships are available with the horsepower assumed and which can exceed the schedule sufficiently to assure its maintenance in the face of fairly stiff head winds. The total scheduled operations per year are shown in Table 1 on the following page.

The above figures, of course, cannot be attained in practice for,—as pointed out in the previous article,—they are subject to deductions for trips prevented or interrupted by bad weather. As also previously stated, deductions will range between 5 and 10 percent. In this case the efficiency maintained should be slightly higher than with the single-engined ships as the ability to fly with one engine "dead" practically eliminates interruptions due to engine system trouble. However, to be most conservative in preparation of these estimates we shall again deduct 10% for interruption although it should be easy to better this performance in actual practice.

Revenue and Total Operations

Allowing for this deduction the total revenue operations (and upon which traffic returns are to be based) will be the figures given in Table 2 on page 26.

However, we must now add the allowance for ferrying of ships and other unpaid flying as in the previous group of estimates. The addition of this allowance provides the figures for the cost estimates. (See Table 3-a on the following page.)

Estimating Overhauls and Personnel

The question of overhauls must now be taken up to provide a basis for calculation of maintenance costs. We shall again assume the conservative basis used in the previous estimates by allowing 1,000 hours between complete overhauls for the airplanes and 250 hours for the engines. The necessary overhauls are shown in the Table 3-b which will be found on page 26.

As in the previous estimates it now becomes necessary to consider the assignment of personnel and equipment. In planning operations and making estimates of this character we find that we must go into these questions at length. Frequently it becomes necessary to actually determine the location of each airplane and pilot from day to day to avoid occasional overworking of pilots and equipment. However, there is no need of our including all of this detail here although we have had to consider such points in preparing the estimates. For present purposes it is sufficient to simply present the results in the accompanying tables. The personnel required, as found by the detailed study of assignments and movements of pilots and airplanes from city to city, is shown in the table of operating costs to follow.

Investment Required

Just as with the smaller ships considered in the previous article, it is again

[1] Air Transport Engineer; President, Black & Bigelow, Inc.; Author of "Transport Aviation," "Civil Airports and Airways," etc.

[2] Industrial Investigations Division, Black & Bigelow, Inc.

assumed that existing airports and hangars would be used. Hence no allowance is made for field and building construction or for the purchase of real estate. All of the other items comprising the investment required are included in Table 4 and explain themselves sufficiently for present purposes. Perhaps it is well to point out here that none of these figures can be "picked out of the air" at random, or be arbitrarily assumed. To make such estimates of any value whatsoever, all figures must be the result of thorough study of operating conditions and based upon known costs of equipment and supplies. The whole value of investment and operating cost estimates lies in their accuracy and, once accuracy is sacrificed to lack of knowledge or evasion of work, the whole series of estimates become valueless. Better no estimates at all than figures of doubtful accuracy. For experience of several years on estimation of airplane operating cost has shown that *"short cut" estimates always err on the low side.* The airline basing its plans upon incomplete

estimates is not merely inviting trouble,—it is going to find it.

Estimating Operating Cost

The completion of the foregoing estimates (and the incidental data eliminated here to save space) now provides us with the basis for compilation of Table 5 of operating costs. This table follows the form of the table included in the previous article and here again a great mass of detail (which was essential to its compilation) has been omitted. This omission has been made for the purpose of relieving our story of some of the burden of detail so necessary to preparation of the estimates themselves. Just as was found in the case of the smaller airplanes,—considered in the previous article,—it will be noted that the fixed operating costs do not increase in proportion with the traffic capacity of the operations. It will be noted also even the variable operating costs, which one might expect to find *exactly* proportioned to the amount of flying, indicate a slight saving for the larger operations. The traffic costs, as might be expected, show a very substantial saving as operations increase.

Three motors, it goes without saying, offer a margin of safety in ordinary day-by-day operation over one motor. A further point in favor of the trimotor ship for passenger carrying, possibly not quite so strongly appreciated, is the fact that the additional power at the disposal of the operator of multimotored equipment not infrequently permits him to maintain his schedules in the face of unfavorable weather conditions, where, perhaps, delay and even postponement might have been occasioned had single engine planes been used. Head winds and storm forecasts are not so likely to interrupt flying on a line enjoying trimotor equipment, and the reputation of dependability is one of the most valuable business assets the airline operator can possess.

TABLE NO. 1

Number of Round Trips Per Day	Number of Miles Per Day	Number of Miles Per Year	Number of Hours Per Year
1	790	288,350	2,884
2	1,580	576,700	5,767
4	3,160	1,153,400	11,534
8	6,320	2,306,800	23,068

TABLE NO. 2

Number of Round Trips Per Day	Number of Single Trips Per Year	Number of Seat Trips Per Year	Number of Revenue Miles Per Year	Number of Revenue Hours Per Year
1	657	6,570	259,515	2,595
2	1,314	13,140	519,030	5,190
4	2,628	26,280	1,038,060	10,381
8	5,256	52,560	2,076,120	20,761

TABLE NO. 3-a

Number of Round Trips Per Day	Revenue Miles Per Year	10% Allowance	Total Mileage Per Year	Total Hours Per Year
1	259,515	25,952	285,467	2,855
2	519,030	51,903	570,933	5,710
4	1,038,060	103,806	1,141,866	11,419
8	2,076,120	207,120	2,283,732	22,837

TABLE NO. 3-b

Number of Round Trips Per Day	Total Hours Per Year	Number of Plane Overhauls Per Year	Number of Engine Overhauls Per Year
1	2,855	2.855	34.26
2	5,710	5.71	68.508
4	11,419	11.419	137.028
8	22,837	22.837	274.044

The Cost per Passenger Mile

The full results of these comparisons become evident as we consider the unit costs derived from Table 5 and which are shown in Table 6. Here it will be seen that every grouping of costs shows a decline as operations increase. The cost per passenger mile, given at the foot of this table, is shown to drop from 13 cents for one trip per day down to less than 9 cents for eight trips per day. These figures may be compared with the drop from about 15 cents to slightly over 9 cents found in the previous study for 5-passenger ships. At first impression a further drop might have been expected for the larger airplane. However, it must be remembered that the trimotor airplane purchase price is more than double that of the smaller ship and this increases costs all down the line. With greater production this price should fall and the operating cost will follow. The daily operation of eight round trips of 10-passenger airplanes brings our traffic capacity up to 80 passengers each way daily. Having attained such volume it now becomes advisable to consider still larger airplanes. In the next and last article of this series, the operation of 18-passenger airplanes will be considered and some very surprising results will be shown.

XUM

Ten-Passenger Airplane Operations

TABLE 4—CAPITAL INVESTMENT

Round Trips Per Day:	1	2	4	8
Equipment				
Cabin Monoplane complete with cabin heater and three 225 HP engines with starters at $44,500, list price	$178,000	$295,925	$440,550	$801,000
Spare 225 HP engines at $4,600, list price	18,400	26,220	37,260	57,960
Set spare wings complete with tanks, flaps, ailerons, struts, etc	6,500	7,500	8,500	13,000
Spare under carriage (crated) less wheels	1,720	3,440	3,440	3,440
Set spare tail surfaces complete	1,260	2,520	2,520	2,520
Set spare wheels with brakes, tires, etc. (crated)	640	1,280	1,280	1,280
Set navigation lights, landing lights, parachute flares with brackets, storage battery and other special equipment	2,748	4,809	7,557	12,366
Trucks: 1½ ton panel body, delivered	1,500	2,250	3,000	3,750
Miscellaneous spare parts and supplies, about	3,000	3,500	4,000	5,000
Miscellaneous crating and shipping costs, about	800	1,200	2,000	3,000
Shop and Office equipment at flying fields, about	4,500	6,000	7,500	10,000
Executive and Traffic office equipment, about	3,500	4,000	6,000	8,000
Total Equipment Costs	$222,568	$358,644	$523,607	$921,316
Organization and Introductory Costs				
Incidental legal and other organization expense	$ 1,500	$ 1,500	$ 2,000	$ 2,500
Engineering services on traffic surveys, selection of route operating bases, planning of operations, etc., about	4,000	5,000	7,000	12,000
Six round trips over route for demonstration purposes—4,740 miles	6,247	5,470	4,555	4,114
Introductory, advertising, publicity, etc., about	5,000	6,000	7,500	10,000
Miscellaneous small expenses, about	2,000	4,000	8,000	10,000
Total Introductory Costs	$ 18,747	$ 21,970	$ 29,055	$ 38,614
Total Equipment Costs	222,568	358,644	523,607	921,316
Total Investment (Excluding working capital)	$241,315	$380,614	$552,662	$959,930
Working Capital				
The amount allowed under this head will depend greatly upon what the traffic prospects are. However for the purpose of these estimates it is considered that traffic available is excellent. In first estimates of this character it seems advisable to allow a sum at least equal to the total of all operating charges for a period of four months, or about	114,147	199,849	336,530	600,921
Total Investment Required	$355,462	$580,463	$889,192	$1,560,851

TABLE 5—OPERATING COSTS FOR ONE YEAR

Round Trips Per Day:	1	2	4	8
Fixed Operating Costs				
Rent of hangars and use of fields at New York and Cleveland and intermediate fields	$ 6,000	$ 10,500	$ 16,500	$ 27,000
Rent of Executive offices at New York	2,000	2,500	4,000	6,500
Depreciation of airplanes, equipment and spare parts (less engines)	28,238	42,106	65,446	121,550
Depreciation of Motor Trucks	500	750	1,000	1,250
Depreciation of shop, office and miscellaneous parts and equipment	1,650	2,025	2,625	3,450
Airplane insurance	41,854	68,338	100,222	178,314
Insurance on Ground Equipment, Workmen's Compensation, etc.	1,450	3,200	5,700	10,700
General and Operations Manager	6,000	7,500	10,000	12,000
Assistant General and Operations Manager		4,000	4,500	5,000
Engineering, accounting, legal and other professional services	5,000	7,500	10,000	15,000
Base Pay of First Pilots at $3,000 per year	9,000	21,000	42,000	84,000
Base Pay of Second Pilots at $2,000 per year	4,000	10,000	16,000	28,000
Chief Mechanics at $4,200 per year	4,200	8,400	8,400	12,600
First class mechanics at $3,640 per year	10,920	18,200	29,120	47,320
Second class mechanics at $3,120 per year	9,360	15,600	24,960	40,560
Utility Clerks at $1,690 per year	3,380	6,760	8,450	13,520
Bookkeepers at $2,080 per year	2,080	4,160	6,240	8,320
Stenographers at $1,560 per year	3,120	4,680	6,240	9,360
Office supplies, printing, telephone, postage, etc., about	1,500	2,000	3,000	4,000
Sub-total	$140,252	$239,219	$364,403	$628,444
Contingencies and Miscellaneous, 10%	14,025	23,922	36,440	62,844
Total	$154,277	$263,141	$400,843	$691,288

Ten-Passenger Operating Costs, Cont'd

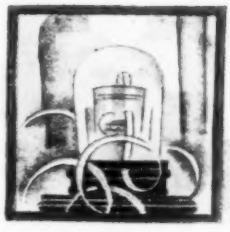
Variable Operating Costs				
Airplane gasoline, oil and grease	$ 34,260	$ 68,508	$137,028	$274,044
First Pilot's mileage pay	14,273	28,547	57,093	114,187
Second Pilot's mileage pay	8,564	17,128	34,256	68,513
Depreciation of engines	17,565	34,836	68,832	137,241
Allowance for crash losses not covered by insurance	3,325	6,650	13,300	26,600
Airplane periodic overhauls	7,138	14,276	28,552	47,104
Engine overhauls	13,704	27,408	54,816	109,632
Trucking, express and freight about	1,000	1,500	2,000	2,500
Motor transport	2,000	2,500	3,000	3,500
Pilots' travel expenses	4,380	8,760	17,520	35,040
Other travel expense	1,500	2,500	3,500	4,000
Telephone, telegraph, mail, etc., on operations about	1,000	1,500	2,000	2,500
Sub-total	$108,709	$214,113	$421,897	$824,861
Contingencies and Miscellaneous, 10%	10,871	21,411	42,190	82,486
Total Variable Operating Costs	$119,580	$235,524	$464,087	$907,347
Traffic Costs				
Rent of Ticket Office space at New York	.....	.....	$ 1,200	$ 2,000
Rent of Ticket Office space at Cleveland	$ 900	$ 900	1,000	1,500
Traffic Manager (New York)	6,000	7,000	8,500	10,000
Assistant Traffic Manager (Cleveland)	4,500	4,500	5,000	6,000
Traffic Solicitors at $2,750 per year	8,250	13,750	19,250	24,750
Stenographers at $1,560 per year	3,120	4,680	6,240	9,360
Clerks at $1,040 per year	2,080	2,080	3,120	4,160
Printing, mimeographing, and other direct mail work on air mail package and passenger development	5,000	6,500	8,500	10,000
Advertising, magazine, poster and miscellaneous	10,000	15,000	20,000	25,000
Publicity work New York and Cleveland	5,000	7,500	8,500	10,000
Commissions about	16,000	28,000	48,000	80,000
Telephone, telegraph and mailing, about	1,000	1,200	1,500	2,000
Office supplies, about	500	600	700	800
Sub-total	$ 62,350	$ 91,710	$131,510	$185,570
Contingencies and Miscellaneous, 10%	6,235	9,171	13,151	18,557
Total Traffic Costs	$ 68,585	$100,881	$144,661	$204,127
Total Fixed and Variable Operating Costs	$273,857	$498,665	$864,930	$1,598,635
Total Operating Costs including Traffic Department	$342,442	$599,546	$1,009,591	$1,802,762

TABLE 6—UNIT OPERATING COSTS

Round Trips Per Day:	1	2	4	8
Fixed Operating Cost per Revenue Mile	$ .594	$ .507	$ .386	$ .332
Fixed Operating Cost per Revenue Trip	234.71	200.31	152.56	131.32
Variable Operating Cost per Revenue Mile	.461	.454	.447	.437
Variable Operating Cost per Revenue Trip	182.16	179.28	176.64	172.76
Total Fixed and Variable Operating Cost per Revenue Mile	1.055	.961	.833	.769
Total Fixed and Variable Operating Cost per Revenue Trip	416.84	379.60	329.20	304.08
Traffic Cost per Revenue Mile	.264	.194	.139	.099
Traffic Cost per Revenue Trip	104.28	76.63	54.94	38.79
Total Cost (including Traffic Costs) per Revenue Mile	1.319	1.155	.972	.868
Total Cost (including Traffic Costs) per Revenue Trip	521.22	456.28	384.17	342.99
Traffic Costs Percentage of Total Cost	20%	16.8%	14.4%	11.2%
Total Costs per Passenger Mile	$ .132	$ .116	$ .097	$ .087

Watch for the *Black & Wheeler* Study on Large Scale Operations of *Eighteen-Passenger Airplanes.* It will appear in an early issue of AERONAUTICS

Picked Up in the Hangars



WALTER WINCHELL relays the one about the newspaper reporter who was invited to take the flight over New York City in the Fairchild equipped with a radio telephone. All the other Park Rowgues talked with their editors by prearrangement, all the passengers listening to the replies from terra firma through the loud speaker. This particular reporter had not notified his editor of the demonstration, so when he finally got the office on the phone the following conversation took place: "Hello, Chief, this is Jim." Back came the querulous reply via loud speaker, "Well, what do you want?" "Say, Chief, I'm talking from an airplane flying over the Battery right now." Clearly and distinctly came the disgusted response: "Good Lord, that damn fool Jim is drunk again."

THE New Yorker tells the one about the officials of the Seaboard Air Line, who were rather astonished by the rise in the railroad's stock. There was no reason for it, as the railroad is one of those conservative steady affairs. Consequently they assumed that some knavish manipulator was up to some skulduggery on the exchange and so they hired a couple of detectives to try to ferret out the mystery. The answer was easy, the public was "in" with its savings in "Seaboard Air Line" because they thought the railroad had something to do with air transportation.

THERE is a paradox in the book "Airplane Transportation" which has made the boys get out their pencils and do a little figuring. It runs something like this: You might assume that the time lost by a fifty-mile head wind slowing down a plane going from Chicago to Cleveland would be offset by the time gained by having the same wind on the tail of the plane from Cleveland to Chicago. Well, it isn't so. Call the air mileage 300 and the speed 100 miles per hour. (As a matter of fact the mileage is 320 and the Wasp motored ships do better than a hundred.) The east head wind slows the Chicago to Cleveland plane down to 50 miles per hour so it would take six hours for the trip. The same wind on the tail of the Cleveland to Chicago plane boosts the speed up to 150 miles per hour and the trip is accomplished in two hours. That makes a total of eight hours for the two trips, one in each direction. In perfectly still weather the planes would each take three hours for the trip. The head wind therefore costs the company two extra flying hours. Figure it out. Don't try to claim that the wind won't slow the plane down that much, or quibble about the details. Just explain it to your own satisfaction.

WE have been wondering if many of our readers caught the statement of Pilot Vance in his Forced Landing story a few months ago. Vance has been flying one of the western mountain routes for so long that he knows every inch of the land. He made the landing after vainly attempting to climb out of trouble and had to pack the mail, and himself, muleback, to the nearest railroad. They had two deep canyons to cross and the road was extremely narrow. Vance says, "At times it gave me heart failure to look down at the river, much the same experience one has looking off the top of a tall building."

IT seems that some resident of Riverside Drive, New York City, became quite exercised recently because of a permit that was issued to one of the air

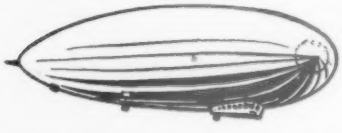
(Continued on page 91)

What's Doing in Washington

By Fred DeWitt Shelton

WASHINGTON continues as the Mecca of all who have great plans in the aeronautical field. The many different government agencies which touch the industry are well known. Furthermore it is becoming known that the man in the White House has ideas so far-sighted and in some respects revolutionary as to stir the imaginations of men who are giving their lives to the development of aviation.

Last week a caller at the Hoover office was Paul W. Litchfield, President of the Goodyear-Zeppelin Corporation. The Ohio Senators, Simeon D. Fess and Theodore Burton, and Representative



Seiberling of Akron, accompanied Mr. Litchfield. It is known that the subject of discussion was the establishment of a dirigible air mail and passenger service from the West Coast to Hawaii. There is a rumor that the German ship, Graf Zeppelin, may be acquired for that service. In any case, it is known that plans for the Pacific line must depend largely on government mail contracts and therefore the Presidential conference. We are told that a friendly interest in the project was evinced by President Hoover.

A TARIFF bill now is the center of attraction for political Washington. It is noted that one of the few industries not begging tariff protection is the aircraft industry. How long until airplane manufacturers will be asking a tariff on foreign manufacturers?

Just now figures available point to a flourishing export trade in American airplanes and parts with prospects of still greater development. In 1928 we ex-

ported airplanes, parts and engines to the extent of $3,664,723 which is virtually the total for the three year period of 1925 to 1927. The chief markets for airplanes were Canada, Peru and Mexico.

IT is said the President is well pleased with the progress of aviation in the United States and that he now is consciously directing attention to the extension of American air service to Central and South America. His utterances during his pre-inaugural tour stressed the need and the opportunities in that field. A huge project of that kind now is going forward, aided and abetted by the Post Office Department, and by enabling legislation.

As a means of coordinating the activities of the federal government President Hoover has instigated formation of an Interdepartmental Committee on Airways. It will consist of officials of the Post Office Department and the Department of Commerce. Business men, chambers of commerce, congressmen and others wanting to promote an air line or landing field can get a hearing by this committee.

In view of the President's insistence on business-like reorganization of the government departments, I would not be surprised to see the interdepartmental plan carried further. The enthusiast who wants to promote an aviation project may know that he can get a lot of help from Washington but he may not know just where and how to go about it. It would take several days to call on all the officials located in the various departments who are prepared to render assistance. Thus, it would not be sur-

prising if there should be set up a central liaison office where an inquirer could be given instructions on how to get service from the Army, Navy, Post Office Department, Weather Bureau, Bureau of Lighthouses, etc.

THE public has accorded Dwight Morrow a high place in its esteem as ambassador to Mexico. He rates fame also as the father-in-law of America's leading aviator. Aviation history, however, will record the truly important pioneering he did as Chairman of President Coolidge's Aircraft Board appointed in 1926 to ferret out the weakness in our national aeronautics policies. That was his entry to public life. This followed the stirring charges of General Mitchell after the Shenandoah disaster.

Time has proven the value of the recommendations made by the Morrow board. Since then the five-year program of aeronautics for the Army and Navy has been adopted and is progressing toward completion. The latest move, looking toward fulfilment of the five-year plan is the introduction of a bill by Representative James of Michigan to authorize $4,529,354 for construction of

special and technical buildings for the Army Air Corps. Mr. James was one of the chief sponsors of the five-year development program and friends of aeronautics, civil and military, rejoice at his elevation to the Chairmanship of the House Committee on Military Affairs.

Ambitions of army fliers, however, received a set-back when the Senate Committee on Military Affairs reported the army promotion bill after dropping out the provision for separate promotion list for the air service. This bill probably will not be passed until the winter session of Congress and then it may be amended before final enactment.

THE Annual Meeting of the Chamber of Commerce of the United States has just been held in Washington. Spirited campaigning was engaged in by candidates for election to the National Board of Directors. Of the eighteen new directors elected aeronautics is represented for the first time—not with one member, but two. One is L. S. Horner, President of the Niles, Bement, Pond Company, which gave the Pratt and Whitney airplane motor to the flying world. The other is Paul W. Litchfield, chiefly concerned with rubber as President of the Goodyear Tire & Rubber Company but interested also in lighter than aircraft through the Goodyear-Zeppelin Company of which he also is the head.

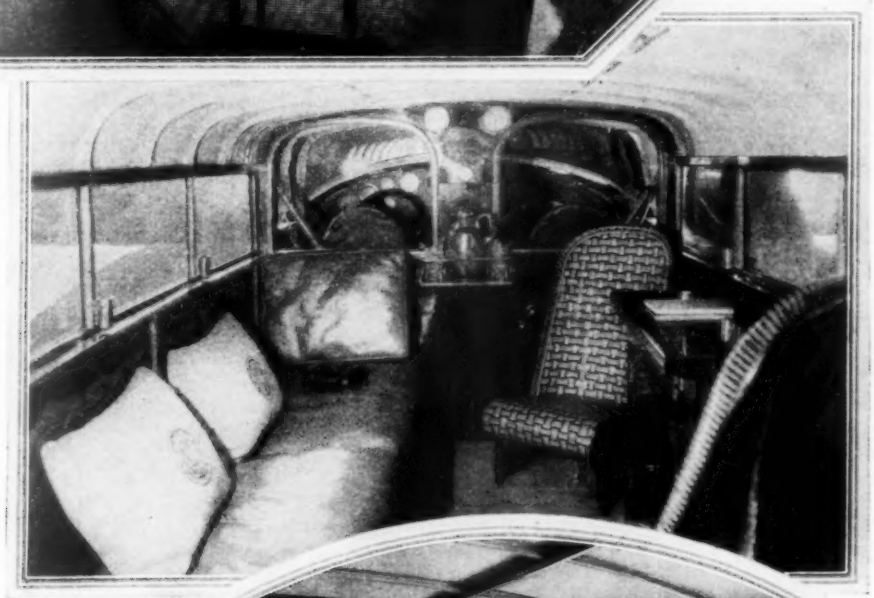
A novel feature of the Chamber's Annual Meeting was an aviation luncheon at which Amelia Earhart, Elinor Smith, Lieutenant Maitland and other flying stars were guests of honor. Other Chamber meetings were in session at the same hour but the aviation program drew the bulk of the delegates. Business men of

(Continued on page 60)

XUM

Interiors with Charm

Cabin of Lockheed-Wasp "Executive" with back of pilot's compartment up.



Interior of Sikorsky Amphibion.

A smart cabin in brown rayon moire. Photo by courtesy of duPont Rayon Company, Fabric Development Service.

Monthly Financial Review

By J. Allen Grover

Pynchon & Company, New York City

FOR the past month the securities market has been threshing about in the doldrums of uncertainty, showing a definite inclination to move ahead with great bravado at times, but almost immediately being frightened back by the spectre of call loan rates. Nothing particularly startling has occurred, and the general situation remains much the same as it was a month ago. The Federal Reserve Board is maintaining its pressure on the market, and various authorities, both political and financial, have issued unavailing philippics on both sides of the question, but to all intents and purposes, the battle which is being waged between Wall Street and the Federal Reserve authorities is still a draw.

Two definitely bearish influences of a general nature have, however, been distinctly felt. One is the deadlock in the Reparations Conference; the second, the uncertainty over the New York Federal Reserve Bank rediscount rate, engendered largely in the last two weeks by the raising of both the Minneapolis and Kansas City rates from 4½% to 5%. This leaves the San Francisco Bank the only one with a 4½% rediscount rate and has given rise to numerous predictions that it cannot be long before the New York Bank will raise its rate to 5½%, or possibly 6%. On the other hand, the major indices of business activity throughout the country continue to hold up surprisingly well, despite the usual seasonal decline expected at this time of the year and in comparison with the corresponding period of 1927. The market has been very definitely a professional traders' affair and the average investor or conservative speculator has found little to excite him in the daily reports of the sessions.

Aviation stocks have, of course, followed the general trend of the market, but in comparison with other classes of securities, have behaved rather better than most. This has been attributable to the formation of some strong new groupings in the industry and the issuance of several encouraging earnings statements for some of the leading aeronautical companies.

New Companies

Comet Engine Corporation: Air Investors, Inc., and the Crocker First Company of San Francisco are the financial agents back of this reorganized aircraft engine manufacturing company. The present concern is a reorganization of the old Aircraft Engine Corporation and will operate at the Oakland, California, plant of the latter company. The product is reputed to be a fully developed type of air-cooled engine made in various horse powers.

The capitalization consists of 125,000 shares of capital stock of no par value, of which 60,000 shares will presently be outstanding. There was no public sale of the issue.

Whittelsey Manufacturing Company, Frear & Co., of New York, and E. B. Merritt & Co., of Bridgeport, Connecticut, have offered 200,000 shares of the Class A Convertible Participating No Par Common Stock of this company at $12.50 per share. There are in all 500,000 shares of Class A Stock authorized and this class of stock is entitled to a preferential dividend of 70c a share in each year, after which it shares equally with the B stock. These shares are convertible at any time into the B Stock on a share for share basis. The B Stock consists of 1,000,000 shares authorized, of which 420,000 will be outstanding.

The business of the company is to manufacture the English sport and training plane, the Avro Avian, for which they own the sole manufacturing rights in America.

At the time of the offer of the stock, officers of the company issued a statement saying that, based on present production schedule (on orders already booked), the company will earn for the period ending June 30, 1930, at least $3 per share on the Class A Stock outstanding.

Atlantic Coast Airways Corporation: This company has offered 10,000 shares of Common Stock no par value at $17.50 per share. The company is capitalized at 200,000 shares authorized and 160,700 shares will presently be outstanding. The company proposes to operate seaplanes between New York and such popular seaside resorts as Atlantic City, Newport and Montauk Point.

De Havilland Aircraft Company, Ltd.: This is not a new concern in any sense of the word, as the company has been operating successfully in England for a number of years, but this is the first opportunity that American investors have been given to participate in its activities.

An American offering of this stock was made last week by several New York brokerage houses. The capitalization of the company consists of 400,000 ordinary shares of £1 fully paid stock, of which the entire amount is outstanding. These American shares do not represent new financing on the part of the company.

The De Havilland Aircraft Company manufactures the Moth plane and the Gypsy engine in England, rights to both of which are owned in America by the Wright Aeronautical Corporation. Shares of the De Havilland company are traded in London on the Stock Exchange and are at present traded in New York over-the-counter.

Changes in Capitalization

The Aircraft Development Corporation of Detroit, builders of an all metal dirigible which will shortly be tested, is undergoing a recapitalization apparently as follows: The new company will have 1,000,000 shares of no par Common Stock authorized, of which original shareholders will receive 150,000 shares, including a stock dividend of 25%, plus an additional option warrant on new shares of the company at $10 per share, in the ratio of one share of new stock for each old share held.

It is understood that the balance up to 500,000 shares of the new stock will be underwritten by a banking syndicate and offered to the public.

Air Stocks, Inc. This aviation investment trust, closely allied with White, Weld & Co., has authorized an issue of 50,000 additional shares of no par Common Stock. Present stockholders are being offered the right to subscribe to new shares at $53 per share in the ratio of one new share for each share held. An official report of this company shows that its net assets have increased 35% since January 15th.

(Continued on page 80)

Lady Heath, Donor of Cup for Women Light Plane Students.

Lady Heath Cup Contest

LADY Mary Heath is offering, through AERONAUTICS, a silver cup, to the value of $100.00, together with an additional prize of $100.00 in cash, to the first woman who learns to fly on a light plane, subject to the following conditions:

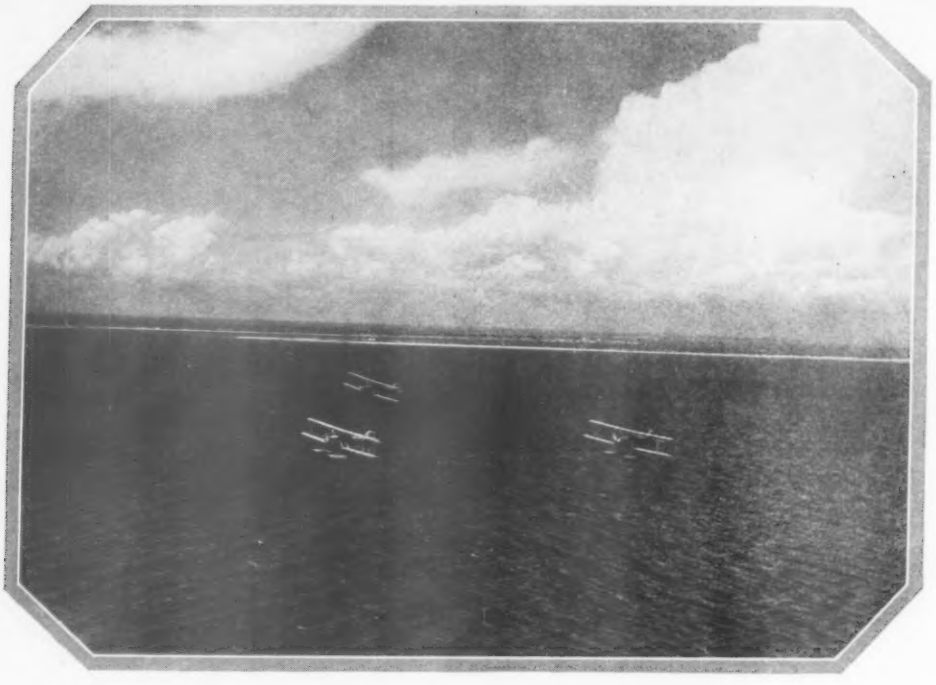
1. AERONAUTICS will be the sole judge of this contest.
2. Contestants shall have had no previous instruction on any type of plane prior to July 4, 1929.
3. All instruction and solo work must be with a plane that comes within the light plane classification; i. e., a plane weighing less than 881 pounds empty.
4. Candidate upon completion of work must be able to fulfill the following requirements:
   a. Three solo flights of not less than five minutes duration.
   b. Another solo flight of at least 20 minutes' duration including a climb to 2,000 feet and a landing within 300 feet of a designated mark.
   c. Entire course of flight training both dual and solo, up to the completion of the above conditions, to be accomplished without damage to equipment.
5. Candidate must file with the Lady Heath Contest Judge, care of AERONAUTICS, 608 South Dearborn Street, Chicago, the following proofs of performance:

First: an affidavit from the candidate setting forth her name, address, and a statement that she had no instruction previous to July 4, 1929, that she had her first instruction on a certain date (day, hour and minute to be specified), and that she complied with all the requirements of this contest, had no instruction other than in a light plane, as within the above definition, and that she completed her instruction and successfully complied with Condition 4 on a certain date (day, hour and minute to be specified).

Second: an affidavit from the head of the school where instruction was received, together with affidavits from the instructor or instructors, to the effect that no previous instruction had been given the candidate, that instruction began on a certain date, giving complete description of all planes used during the candidate's instruction and solo work, and that the candidate complied with all requirements, and successfully complied with Condition 4, above, on a date that should be specified by day, hour and minute.

Third: an affidavit signed by two disinterested individuals who are competent to judge, to the effect that Condition 4 was successfully complied with in their presence on a date specified by day, hour and minute, and in a plane, which must be described.

(Continued on page 98)



Flight Training the Navy

By K. M. Painter

Part 2

INCONGRUOUS as it may seem, of the five squadrons in which a fledgling Naval aviator receives his flight training, Squadron Two, a landplane rather than a seaplane squadron, is his severest test. The student who enters the second phase of training has about sixty hours in the air and is considered good flying material—a reputation which he must maintain. While in Squadron One—with its NY-2 seaplanes—he has been forgiven much for his lack of experience; in Squadron Two no errors are palliated. Every "wrong move" is put down to lack of ability, and the unfortunate student is dropped. In this Squadron the aspirant for wings gets down to his first practical flying, and in addition to perfecting his air work, he receives elementary instruction in the rudiments of military flying. If he is successful in passing this phase of training he has more than a fair arithmetical chance of passing the whole course, for after Squadron Two only fifteen per cent of the class are dropped in the remaining squadrons. But Squadron Two—like Squadron One—has a large number of failures; about 30 per cent of those starting the phase.

Upon reporting to Squadron Two, the student is assigned to one of the thirteen squadron instructors and receives one hour's flight instruction every day for five days. Time not devoted to flight instruction is spent in overhauling engines and other ground school activities. If, after five hours of dual instruction, the student is recommended by his instructor, he is given a solo check by the commander or executive officer of the squadron. If, however, the instructor does not consider that the student is ready for a solo check but thinks that with more time he may be qualified, he recommends another hour's instruction; which makes a possible six hours' instruction before the solo check—the maximum period allowed. The solo check—as the name indicates—is a check only on the essentials necessary for safe solo; takeoffs, turns, regular and emergency landings. Failure to pass the check calls for a re-check by another test pilot. Failure to pass the second check automatically drops the student from aviation; but passing this check, he must pass still another. Successful at last he, as well as those who passed the solo check the first time, is entitled to solo one of the forty NY-1 landplanes. These planes have the same power plants—Wright Whirlwind motors—as the NY-2 seaplanes of Squadron One, but they have shorter wings and are more difficult to fly. A student never fails to be surprised when, in landing, these planes "drop out from under" him. He is accustomed to the planes in Squadron One with their longer wings sustaining them so that they settle more slowly.

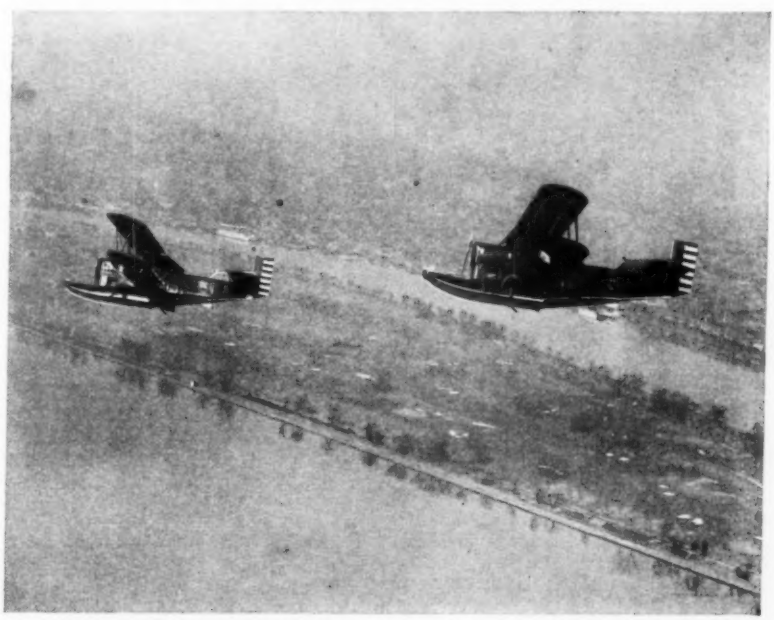
Primary solo involves 180 degree and 360 degree spirals to a precision landing. Landings must be made within fifteen feet of the mark—a distance less than half of that required in commercial pilot's examinations. A check is made on the student's accuracy and his ability to land the plane in small fields. A large percentage of failures result from this check, since the Navy decrees that to be consistently safe a pilot must be consistently accurate.

And, now the successful student is on the brink of his long-considered real stunting. Ever since his first spin in the seaplanes of Squadron One he has had a sneaking fear of his ability to stand stunts, and this fear has been magnified

by anecdotes of students who have made Immelman turns, falling leafs, and cartwheels, in landplanes. Although there has never been an instance of failure because of this physical weakness, there have been students whose planes needed cleaning after every flight until their airminds triumphed. Perhaps the most difficult stunt to perform in the training syllabus of Squadron Two is an Immelman turn, and as such warrants description. The purpose of this maneuver is to reverse direction, at the same time gaining altitude. Since the NY-1 is a comparatively slow plane, and because it is necessary to have a speed of 120 knots per hour to perform the maneuver, the plane must be put into a dive to attain the required momentum. Then the nose is pulled up vertically as if for a loop. Just before the plane is horizontal with the earth in an upside down position, it is maneuvered for a half roll, and is then heading in the opposite direction, having gained considerable altitude. To properly execute this maneuver a nice perception of timing is required—gained only by practice. And, practice means repetition which often results in a sensation not unlike that of the first cruise.

The student is checked on Immelmans, wingovers, 8's, spins, cartwheels, falling leafs, rolls, and loops, and a passing mark entitles him to enter upon the phase of Squadron Two's training which is devoted to formation flying—so far the first real military-flying instruction he has received. Formations of three planes take-off and land together in this squadron—in more advanced squadrons they take-off individually and meet at a rendezvous. For the first two hours of formation flying an instructor rides with his student—each plane carrying an instructor and a student. Take-offs and landings are practiced, in Vee formation. Then the students fly four hours alone—still in Vee formation. They are given an hour's instruction in flying echelon formations, and crossing over from Vees to echelons. At the end of another four-hour practice period, they receive a check on the formation. Considered in this check is the regularity of the formation, correct spacing (about 50 feet for this type plane), and line of bearing.

In landing and taking off in formation, the student is schooled in the necessity of watching that part of the ground for which he is visually responsible. Thus, the man flying position two—left of the leader in a Vee formation—is on the lookout for field-obstructions to the left; the man flying position three—right of the leader—is on the lookout for field-obstructions to the right; and the man flying position one—leading the formation—keeps his eyes ahead. Planes in position two and three take off before the leader since they fly at a higher altitude, and there is a tendency on the latter's part to look behind and make sure that the other planes have left the ground before he takes off. The first tenet of formation flying is confidence, and in looking back the leader displays no regard for his followers' ability. This is as bad as it is dangerous, and the recent ground-crash which resulted in two fatalities was directly due to a formation leader's unheeding the first rule of successful group-flying. Three NY's were practicing take-offs from Squadron Two field. The leader of the ill-fated formation looked back, and before he realized what was happening he had headed his plane into the safety area and its propeller was ploughing through the parked plane, the tail of which was its first obstacle. When the propeller reached the gasoline tank—the work of seconds—both planes caught fire. The student and instructor in the parked plane were killed, and the student flying the formation was badly burned before he could flip his safety belt and climb out of his burning plane.



The final stage of formation instruction in Squadron Two is an eight-hour cross-country flight. Three plane formations make this trip, having for their objective a field four hours distant. There they take on gasoline, and fly back together. If a student has a forced landing on this flight he is thrown entirely upon his own resources, in strange country. Some weeks ago the leader of a cross-country formation developed engine trouble which necessitated an immediate landing. His description of his first recourse to an emergency landing should be interesting since it resulted in commendation from the Commandant of the Air Station, Admiral J. J. Raby.

"I was leading a formation of three NY's on a cross-country to Pascagula," explains Ensign Ward. "Each plane was piloted by a student and carried a mechanic. We were about 18 miles out from Pensacola, flying at an altitude of about 4,000 feet, and I could see Foley on the left, and Mobile Bay in the distance. I checked up carefully on my instruments to be sure the engine was functioning perfectly for the over-water part of the hop since the ceiling was too low to permit a really safe altitude. The oil pressure had dropped three pounds—not serious, but worthy of notice. I saw that the 'mech' noticed it too, but he smiled; that much didn't matter. But the pressure gauge now held our attention, so we were interested spectators when some thirty seconds later it began to drop like land values at the end of a boom. We saw it hit 50, hesitate, and then drop swiftly to zero.

"I looked at the mechanic for confirmation of my doubts, since he was directly responsible for the condition of the engine. He grinned and pointed down. There wasn't much doubt about it. Lack of oil will ruin a good eight-thousand-dollar motor in less time than it takes to soft boil an egg. So I cut the gun and turned back toward Foley with little more than enough altitude to make it. With the motor off, it was nice and quiet so I asked the 'mech' if there was a field in the town. He replied that there was a ball park, so with no other alternative

I decided to land there. Imagine my embarrassment when I got close enough to see that the park was only an infield surrounded by wires. I certainly deplored the home team's lack of heavy hitters.

"Still having a little altitude, I turned to the right in search of landing space. The fields were tiny and ploughed. The wind was across the road, and there were telephone wires alongside—I couldn't land there! Then I saw an unploughed stretch about the size of a conservative back-yard; but its length was parallel with the wind. Being just a little past the down-wind end of it, I turned with a steep bank and dropped over the fence in a nose-high side slip, straightened out, and we touched in a perfect landing. Although I had sizeable wads of cotton in my ears; despite the yelling of the delighted children running toward us, I had no trouble hearing the mechanic's sigh of relief. In fact, I sighed myself!"

After the cross-country hop, the student goes up for an altitude test. To pass this phase, the pilot must take the plane up as far as possible (about 12,000 feet) without suffering any physical effects from the altitude. He is then ready for the final check which determines whether he is to be promoted or dropped. Considered in this check is all the work of the squadron which must be executed smoothly as well as safely; take-offs, turns, acrobatics, emergency field work, and landings.

The student first flies a service-type plane in Squadron Three. In the first two squadrons he has received instruction in primary-type planes designed exclusively for instruction purposes and not met elsewhere in the service. From now on he will fly planes of the type used with the Atlantic and Pacific fleets. Squadron Three is concerned with the heavy seaplanes—T-3-M's and SC's—designed for torpedoing and bombing. These planes have 800-horse power motors—four times the power of the primary-type planes—and are so heavy that they are controlled by a wheel and yoke instead of a stick. Previously the student has been confined to two-place planes, but these "big boats" carry five comfortably.

Because of these differences it is imperative that he have instruction before attempting to solo. After he passes a check, he is allowed ten hours' solo-time to perfect his handling of the plane. He is then ready to work upon its various military missions. Since most military flying is done in formation, he is given practice flying three, five, and six-plane formations.

In ground-school the student has mastered the theory of bomb sights and torpedo directors. He is now ready to put these theories to practice, starting with the bombing planes—T-3-M's. Two students fly together, alternately designated bomber and pilot. For the first two hours of practice they fly individually, dropping miniature dummy bombs from an altitude of 2,000 feet. Still flying individually, the altitude is increased to 4,000 feet, for the next two hours of practice. Then the student is ready for live bombs.

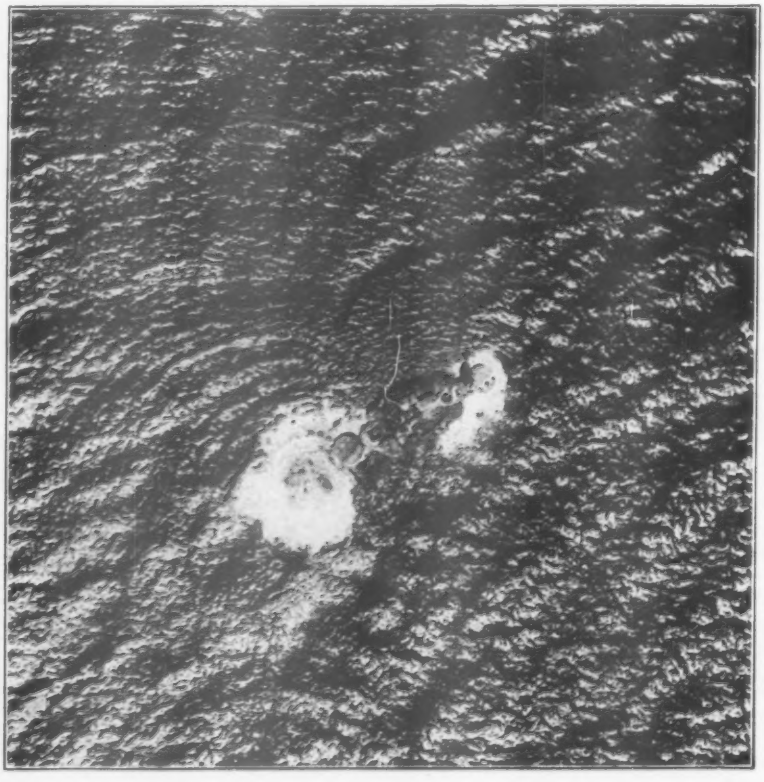
Outside of Pensacola Bay, in the Gulf of Mexico, lies the old battleship Massachusetts—sunken, but with its upper decks just awash. Robbed of its glory, this veteran now proxies for the enemy, serving as a target. Live bombs calculated to rend its decks are dropped from an altitude of 5,000 feet, but the anti-submarine bombs used in practice lack sufficient charge to accomplish the purpose. An instructor watches the drops from another plane to check on the student's accuracy—while engaged in this checking, the instructor is known as an observer.

The student is now ready for formation bombing. Large dummy bombs about five feet long are used in this practice, and the Massachusetts serves as target. A student designated as bomber in the leading plane of the formation sights the target, and the pilots of the other planes in the formation signal their bombers to release when they see the bomb released from the leading plane. It would seem that this daily water-disturbance would discourage fishermen, but a few months ago a staunch disciple of Izaak Walton was "tied up" to the Massachusetts, enjoying the quiet that is conducive of a good catch, when a three-plane bombing formation hove in sight, five thousand feet above. From that altitude, it was impossible for the bomber to sight the small boat alongside the target, and only after he had released his ominous missiles did he see a speck dart out from the target. His drop acted as a signal, and four more bombs were on their way. Fortunately, the man in the boat escaped, but it must have been a thrilling few minutes for him, as it was for the bomber who saw his drops make a pattern around the panic-stricken victim. As far as the fisherman knew, the bombs were loaded, and even after they had safely hit the water, he could not be sure that they wouldn't explode and send him and his frail craft flying into space.

Formation bomb-

(Continued on page 82)

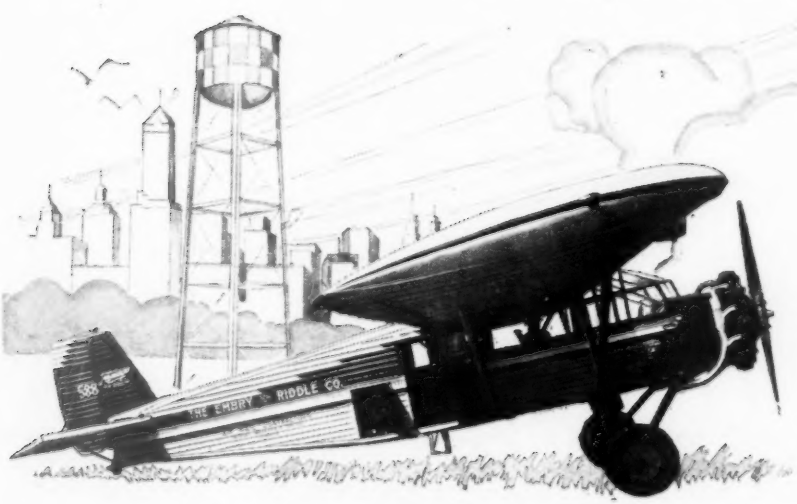
Enlarged from a photo, taken at 6,000 feet, showing a hit on the old Massachusetts.



Three of the Latest—

This Lockheed Wasp Vega, pontoon-equipped, slips off the water in fifteen seconds with a full load of nearly 1,500 pounds, including a pay load of 750 pounds, 85 gallons of gasoline, 8 gallons of oil, and 210 pounds of pilot. The Vega seaplane flies wide out at 150 m.p.h., cruises at 130 m.p.h., lands at 50 m.p.h., and has a range of 650 miles.

Many a sack of mail has been taken for a ride in Stearman mailpits. This plane, as flown by the Varney Air Lines and the Western Air Express, is powered with a Wright Whirlwind. It has a top speed of 126 m.p.h., a cruising speed of 105 m.p.h., lands at 41 m.p.h., climbs 1,000 feet a minute from sea level, and has a service ceiling of 18,000 feet.



The Flamingo is a new six to eight place steel and dural monoplane manufactured by the Metal Aircraft Corporation of Cincinnati. It comes with Hornet or Wasp equipment and flies at top speeds of 140 or 135 m.p.h., respectively. It cruises at 120 or 115 m.p.h. The Flamingo Hornet carries a useful load of 2,540 pounds and a pay load of 1,355 pounds. The Flamingo Wasp carries 2,640 pounds of useful load, and 1,455 pounds of pay load. The checkered water tower comes extra.

Roland G. Garros in the tiny Demoiselle. Both he and Audemars succeeded in flying this tricky little thing from an altitude of 7,240 feet at Mexico City.

Latin-America's First Bird Men

By H. H. Dunn

FLOWN from an uneven field nearly a mile and a half above sea-level the first aviation meet ever held south of the Rio Grande has been a matter of history for over eighteen years, yet in it were performed, with light and crazy monoplanes of low power, some of the most daring stunts seen until the war in Europe developed battles in the clouds. The writer has particular occasion to remember this "flying circus" of February, 1911, because he was instrumental in making the arrangements with the government of Mexico for the meet, and because, had it not been for the activity of one department of that government, he would have failed to collect his share of the proceeds.

With the daring which marked the short but brilliant career of another of the same name, John B. Moissant set out from New Orleans with five aviators, four of whom could fly, and five Bleriot monoplanes, modified in minor particulars, and renamed "Moissants," in honor of the owner and manager of the show. With an assistant manager, and two mechanics, they arrived at Mexico City, by way of Vera Cruz, while three revolutionary armies of considerable size were slowly closing in on the capital of the southern republic. The movement of these armies, led by Francisco Y. Madero and Pascual Orozco on the north, and Emiliano Zapata on the south, made any trip to Mexico by Americans fraught with real danger. Especially was there danger in taking to that revolt-torn country such valuable baggage as airplanes.

The revolution later resulted in the ousting of the president, Porfirio Diaz, who had ruled the country with an iron hand for 35 years, and the seating of Madero as chief executive. But, on February 20, 1911, when Moissant and his flyers arrived, there was no peace in Mexico, outside the capital, which itself rested on a political volcano that might at any moment blow the whole city higher than any of the aviators cared to go. With the support of President Diaz, which I had obtained, and with a guard of an entire regiment of federal soldiers, however, a "flying field" — if such it could be called, was laid out on a plain at Peñones, a suburb of Mexico City, only a few miles south of the national palace.

There were unloaded the five monoplanes and their riders. There was Charles Murphy, who never left the ground; Roland G. Garros and Rene Barrier, who made names for themselves in the French flying forces during the World War; Edmond Audemars, whose greatest claim to distinction was that he flew the smallest plane then known; and Rene Simon, youngest of the adventurous crew, a reckless daredevil who is still remembered in the beautiful capital of Montezuma and Cortez and Juarez.

There were no hangars, no runways, not even a leveling off of the field, and no stands or fences. By efforts so effective that they still surprise even me, the one who made them, we succeeded in getting three sides of the field enclosed by a high barbed-wire fence; "bleachers" of undressed boards erected in sufficient quantity to house 15,000 spectators; boxes with chairs, graced by the name of "palcos," set up for the distinguished guests; and two huge tents placed at the city end of the field, to serve as hangars. All this was accomplished in less than a week, and to those who know the futility of trying to move a Latin-American at more than a slow walk, the task may seem Herculean, but when Garros' mechanics rolled out his little Bleriot for what was to have been the first flight, on the 25th of February, the

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Here's a typical report giving actual facts on the performance of the Kinner Powered American Eagle Biplane: "Arrived Montgomery from Kansas City with no adjustment of any nature in motor or ship. Following figures based on 1,032 miles: Cruising flight 15 hours average, 8.8 miles per gallon, 7.8 gallons per hour. 125 miles per quart of oil. 70 miles per hour against head wind to Birmingham. Cost of gas and oil 2.5¢ per mile."

***(Signed)* L. G. MASON,**
President Montgomery School of Aeronautics; Montgomery, Alabama

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Garros and the Bleriot, in which he climbed to 4,758 feet above the valley of Mexico, itself 7,240 feet above sea level. Garros afterward flew over the Alps and across the Mediterranean, and was an Ace in the World War.

field was as ready as it could have been made if a month had been spent on it.

Then came the joke of the meet. Just as Garros stepped into his machine preparatory to taking off on what had been widely advertised as the "first flight" from an altitude of 7,240 feet, the actual elevation of Mexico City, and with a crowd of 10,000 people watching, a clumsy biplane rose from the opposite end of the field. In it, chortling with glee and wildly applauded by all the spectators, was Alberto Braniff, a native of Mexico, who, it later appeared, had vowed that no "Gringo" should make the first flight from Mexican soil.

So secretly that even the newspapers did not know of it, Braniff, member of an immensely wealthy family, had imported a Farman biplane, only a little more stable than the monoplanes. This plane, looking more like a huge box kite than anything else, he had assembled in an old shed not far from the field, and there, in fifteen days, without an instructor, had learned to fly it. In it, Don Alberto, wabbling now this way, now that, dipping and rising like a duck looking for a place to alight, managed to rise to a height of about 300 feet, afterward announced as 500 in the newspapers. He circled the field twice or three times—my memory fails me after more than seventeen years—and came down directly in front of the tent-hangars of the Moissant aviators.

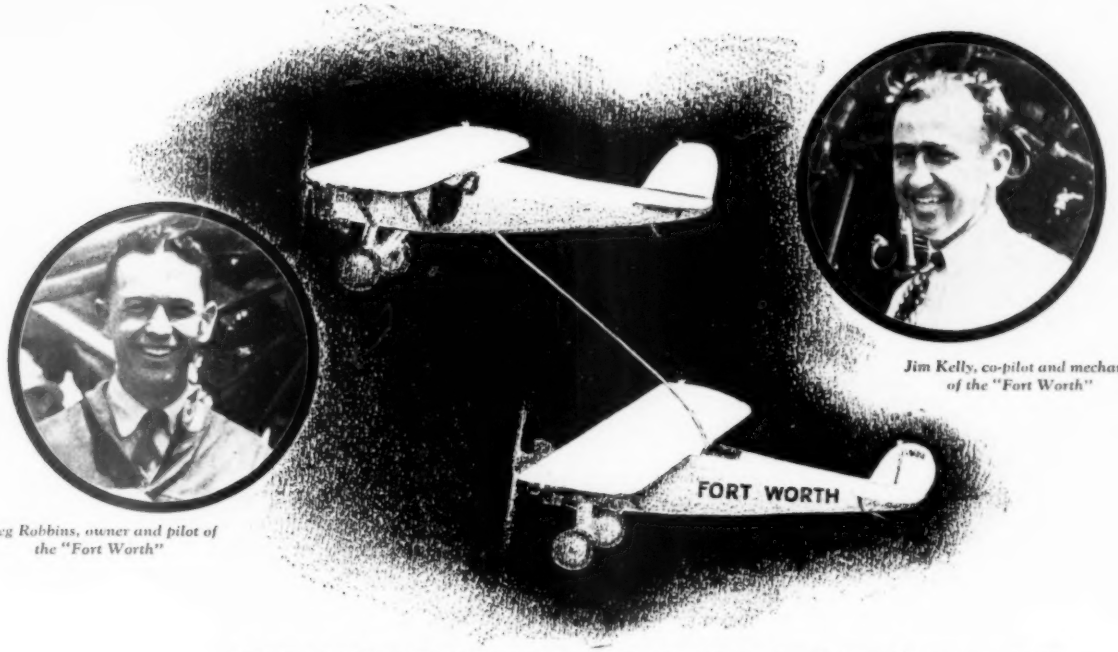
Erratic as his flight had been, it was all his own, and his landing was as perfect as any made later by the foreign flyers. Braniff clambered out of the high cockpit, and, helmeted, goggled and sweatered as if for an altitude climb, advanced with both hands extended, to "welcome the visiting bird-men to the soil of Mexico." There was nothing to do but take the young millionaire seriously. As a matter of fact, he had done a daring stunt, but one which made John B. Moissant's stiff mustaches crinkle with something much akin to anger. After a while, however, the point of the joke hit Moissant amidships, and he laughed as heartily as did President Diaz and Guillermo de Landa y Escandon, governor of the Federal District, who together watched the "native son" do his stuff.

The Third Regiment Band broke into the soul-stirring National Anthem of Mexico, to which it did full justice, since it was one of the best among several good bands in a land where music is an integral part of life. Then it played "America" with some success, and, emboldened by this, struck up "For He's a Jolly Good Fellow!" Fortunately, by this time, Garros was taking off, and the center of interest passed from the band to the flying field.

Garros, Barrier, Simon and Audemars were of that tribe known as "born flyers," else they never would have essayed to rise in those flimsy crates from such an elevation. Unfortunately, the diminutive Audemars did not get the opportunities he might have had in this meet, but when he did have a chance, he performed as well as any of them. On this first flight, Garros, unaccustomed to the altitude—though he afterwards flew the Alps—made three low circles of the field before he could lift his Bleriot above 500 feet. Then he began to climb, and as the dragon-fly body of the plane faded into the blue, Simon and Barrier took off simultaneously, with a combined roar of motors that would be drowned by one Wasp of today.

Soon, they joined Garros in the sky, and, together or separately, planed down over the heads of the spectators, ninety-nine per cent of whom had never seen a plane until that day, to rise again in long, upward curving lines of flight that seemed to touch the 20,000-foot peak of Popocatepetl, the sleeping volcano half a hundred miles away. Then they cut pigeon wings and did other evolutions in the sky, chased each other's

The aviators at the Mexico City Aviation Meet. (1) Charles Murphy; (2) Roland G. Garros; (3) Rene Barrier; (4) Edmond Audemars; (5) John B. Moissant; (6) Rene Simon.



Reg Robbins, owner and pilot of the "Fort Worth"

Jim Kelly, co-pilot and mechanic of the "Fort Worth"

Refueling the "Fort Worth" with -TP- Aviation Gasoline on her flight which began at 11:33 a. m. on Sunday, May 19, 1929, and lasted until 4:05 p. m. on Sunday, May 26, making a world's endurance record of 172 hours, 32 minutes, 1 second. This betters the former record by 21 hours, 51 minutes, 10 seconds.

"-TP- SOLVES THE PROBLEM OF AERO MOTOR LUBRICATION."

(signed) Reg Robbins

IN a letter addressed to the Texas Pacific Coal and Oil Company Reg Robbins says:—

"During my recent endurance flight in which a new record was set at 172 hours, 32 minutes and 1 second, your -TP- Gasoline, -TP- Aero Motor Lubricating Oil, and -TP- Aero Rocker Arm Lubricant were used exclusively and gave perfect performance throughout the flight. The motor in my ship, Fort Worth, had had approximately 525 hours before starting this flight and was still operating smoothly when we were forced to land on account of an accident to the propeller. The oil strainer was not cleaned during the flight and the valve tappets showed but seven-thousandths of an inch wear. Having used your products exclusively for the last year I was confident that insofar as lubrication was concerned there would be no cause for worry. I believe that your oil and rocker arm lubricant have solved the problem of aero motor lubrication. The record itself is sufficient proof of the results secured using Texas Pacific products."

The products referred to were supplied from the regular stock at the Fort Worth Municipal Airport.

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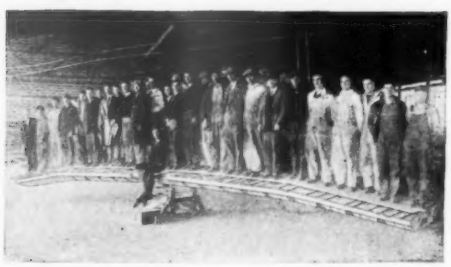

Surprising Wing Strength

This photograph of thirty-eight men standing on the Barling NB3 patented wing gives some idea of the great strength *engineered* into the wing. Six and one-half times the total weight of the ship has been successfully applied to the wing —without any indication of weakness.

The New-Day Barling NB3 takes off from a background of established stability. Its manufacturers, the Nicholas-Beazley Airplane Co., Inc. are not adventurers in the field of aeronautics. This firm, already America's foremost aviation supply house, enters the manufacturing division with experience—valuable in both the production and marketing of this New-Day Plane.

And the NB3 is not just another airplane. It is an entirely new conception of construction and performance—embodying the qualities that give popularity and salability.

Performance is phenomenal. Record after record has been shattered by the NB3—and inherent stability permits the novice to fly it with ease.

Amazingly low in price, this all-metal structured, three place, low-wing monoplane, completely equipped, is only $3600—fly away Marshall.

Successfully established dealers may still obtain franchises in a few desirable territories.

NICHOLAS-BEAZLEY AIRPLANE COMPANY, Inc.
Manufacturing Division Marshall, Missouri

BARLING NB 3 Monoplane

Danger that lurks in a FROZEN STICK is eliminated

By Design and Equipment the Whittelsey Avian is the finest plane in the world for training and sport.

THE OUTSTANDING SPORT AND

IN the records it holds the Avian has a real claim to fame—England to Australia, first solo flight—longest flight in a light plane—fastest time England to India—longest solo flight ever made.

But this famous light plane has achieved its real record in training and club flying. Piloted by all types of flyers, flown through the varying climates of the earth, the Avian has justified the confidence of its builders. Years of air miles have set it apart as the safest, most enduring, most stable light plane in the world. Only such superlatives can describe the air-worthiness of this light plane.

Safety is Added to Safety

Now the Avian, which by design boasts of a great margin of safety, has added to its equipment one of the outstanding achievements of modern aerodynamics—the Handley-Page wing slots.

The slotted wing accomplishes the following: Permits stalled turns without falling into a spin—enables ship to regain flying speed after stall with less loss of altitude than usual—materially improves lateral control by decreasing the counteracting yawing moment—decreases landing speed—practically eliminates possibility of ship going into spin in clouds or fog.

SAFER LANDINGS. Split-axle undercarriage with its unusually wide track, exceptional strength and greater resilience insures safer landings on rough ground. The Whittelsey Avian can be turned in its own length.

Designed for the sportsman too. The wings of the Whittelsey Avian can be folded by one person in a few moments. The telescopic jury struts, which must be placed in position before folding, are automatically slipped under the upper wings when not in use. With the wings folded, the Whittelsey Avian can be housed in a small shed.

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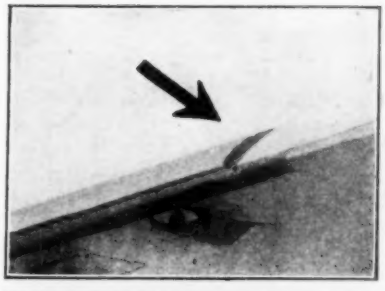

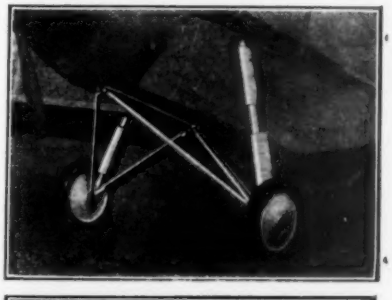

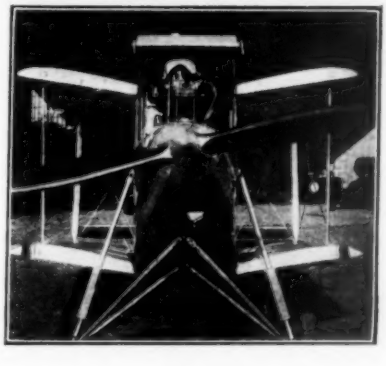

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TRAINING PLANE IN THE WORLD

tails back and forth over the field, sending a flock of half-wild mules in headlong flight toward the hills, and then, together again, came to a landing with scarcely ten feet between them. The writer has watched hundreds of planes at play since that February day in 1911, but never yet has seen any evolution more beautiful than the finishing flourish of Garros, Barrier and Simon put to that first of their many flights from the ancient Vale of Anahuac.

On another day, Simon flew across Mexico City, with its nearly a million inhabitants, to drop a leather message case at the feet of President Diaz, as he walked on the great stone platform which fronts the Castle of Chapultepec, summer residence of the rulers of Mexico. The dynamic President, then more than 70 years old, picked up the case, read the message, which was from Manager Moissant, and waved his black rosewood stick enthusiastically at the young Frenchman swinging in a wide circle above him. Later, the president desired to be taken aloft by one of the flyers, but his official family finally dissuaded him, though I may say without violating any confidences, that all of one afternoon it much appeared that one of the planes would be commandeered and one of the aviators "invited" to take President Diaz aloft.

Again, circling the city, Simon saw beneath him the skyward-pointing stone towers of the ancient Cathedral, nearly four hundred years old. Pointing for them he flew just over their tips, and, circling about over the western section of the city, returned to put his monoplane directly between the twin horns of the great church. On this accomplishment the populace was divided, about half being stricken with awe at the feat, the other half with wonder that this God-defying bird-man was not instantly slain by the Deity in whose honor the towers bore gilded crosses! This piece of audacity got the Moissant aviators more space in the native-language newspapers than all the rest of the aviation meet, but, oddly enough, the Mexican "Herald," an English daily, thought more of the incident when Barrier chased a flock of blackbirds all over the flying field, herding them hither and yon as a *vaquero* on a highly-trained cow-pony might raddle a herd of cattle.

And, indeed, this was the most foolhardy stunt of the meet, for, had one of these birds hit Barrier's propeller, the forecasts of the Mexican editorial writers concerning inevitable tragedy at the flying field might have been fulfilled. As it was, the meet went off without an accident, and met with the combined approval of Mexican government and people, while it also aroused tremendous interest in aviation in all the lands to the south of that republic.

Out for an altitude flight one clear afternoon, Garros rose to 12,192 feet above sea level, or nearly 5,000 feet more than the altitude of 7,240 from which he started. Technically, this was the most interesting incident of the meeting, but it aroused little interest in the native or foreign press. When Audemars brought out the tiny Demoiselle monoplane, less than half the size, even, of one of the Bleriots, he attracted more attention in his efforts to get into the air than did any of the other aviators with their regulation planes. And Audemars finally succeeded in flying the tricky little Demoiselle, as did also Garros, but none of the others would attempt it. The motor and fuel tanks were above the wings, which were shaped more like those of a bat than an airplane, and one rather expected them to flap in place of remaining stiff and quiet. When Audemars took off in this queer little "bug plane," as the Mexican reporters called it, the crowd broke through the wooden barriers, brushed aside the soldiers with their little monkey caps and unloaded rifles, and surged around him on the field.

All the panoply of government in a land of paternal dictatorship was there, with the president and his family arriving at the stands one day in a huge carriage drawn by spanking black horses and surrounded by the presidential guard with drawn sabers. On the next day, Diaz would appear in a huge foreign limousine, his horse guards having the time of their lives trying to keep up with the automobile.

Society—some of it straight down from Cortez and Montezuma's sisters—also was there, in all the power of Spanish-American beauty, which is certainly among the most amazingly beautiful beauty on earth. Ambassadors and Ministers, consuls and officials of nations and states, attended *en masse*, and it is doubtful if there has been so small an aviation meet in the history of flying which ever attracted so many notables to so poor and ill-prepared a place.

It was a romantic enough experience, with the lazy charm of the old capital, the glamour of the undertaking itself, and the attention paid us by the people of the city. Though flying is still an exacting mistress those who wooed her eighteen years ago felt her caprice in a greater measure. We were, in a sense, a barnstorming circus troupe, but in a larger sense, we were the advance representatives of a whole new era of human adventure and enterprise.

The final day of the meet, after each of the visiting flyers had been presented to the president and other dignitaries, more than twenty valuable cups and gold and silver trophies were presented to them. Probably I shall be violating no confidence, again, when I say that twenty-four hours later, virtually all of them were in the National Pawnshop. To this it should be added that none of them were placed on display, or offered for sale, until the aviators and their Bleriots were on board ship, safely out of Vera Cruz harbor, bound for New Orleans once more.

The author, H. H. Dunn, who obtained the support of the Mexican Government for this meet.

Rene Simon, the youngest of the flyers, who flew over the towers of the Cathedral at Mexico City.

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I Could Fly—Just Give Me a Plane!

The Experiences of a Pilot's Wife

By Kathryn Ward

On the beach of Squadron One at Pensacola.

"Be sure to step on the wing bracing" is a necessary preliminary but a difficult business in plus-19's.

"IT can't be done—a man might as well try to fly," said our ancestors when they wanted to express the limit of human impossibility, and thereby imperiously implied that what man couldn't, was entirely out of the question for woman. Now I'm married to a man who flies—who holds a Naval Aviator's designation—and I've come in for my share of flight discussions. I've run the gamut of nervous emotions that precedes a student's final check, and I've heard the inside story about "bilging" a high-ranking officer, but I've never been impressed. I've always felt that if women had an opportunity—! And so I got my chance.

But to go back to the beginning of my flight career. In the Spring of 1924 my cousin—who flew with the Army in France and now operates a commercial flying field in Virginia—came to Washington, D. C., with one of his planes and invited me to ride down to Portsmouth, Va. It was the time of the County Fair, and the Chamber of Commerce had expressed its desire for a passenger-carrying plane. Roy came to the Capital on a memorable Friday night, and most of the time between then and Saturday morning at ten o'clock was spent in convincing my mother that flying was a safe business. As I remember the arguments they were pretty good, though what I could say about flying at that time is questionable for I had never been in a plane. But mother and I were on like ground, and I must have been in better form, for the siege was successful.

I was writing features for a Washington paper at the time, and I thought the flight would make a peach of a story, so I took along a note-book and pencil with the hope that something would happen. Maybe I intended to write my last impressions of life. I don't know, for I never made an entry. I was too chagrined. The first move I made was so disastrous that it brought forth anathemas which even now I recall with a shudder.

I never went in for the out-of-doors-girl movement, and I made no exception in flying. Of course I wore a helmet, but no knickers and flat soled shoes for mine—I've since changed my mind, by the way. So it was that I walked up to the silver-coated Waco shod in the current manner, with heels as high as Perugia pleased, and at that time he pleased to have them high indeed. My cousin beamed on his silvery bird-child, and introduced me to the pilot, a Captain Myers, of the Royal Flying Corps, who has since won more laurels to add to his already leafy crown. I was told that I was to sit in the front cockpit with Roy, and Captain Myers clambered into the rear seat. I tried to step where he did—and I want that to go on record—but r-r-ip went the wing covering, for my French heel had pierced the fabric.

Finally Roy ran out of words and stepped in beside me. "Contact," yelled a field-mechanic, and I blush to admit that I jumped up. I was sure that I'd done something else, like kick a switch or what-have-you? I was much relieved when Roy pulled me back and the propeller whizzed around to the tune of the engine. We skimmed along the ground, and I waited for the noise to stop. We took off, and I still waited. We climbed higher and higher, and the motor kept up its incessant thundering. I don't know what I expected, maybe I thought we would soar along like a glider, but it was certainly a surprise to me that it was impossible to carry on a tete-a-tete in an airplane. All things considered, it was probably just as well, for Roy was in a decidedly unfriendly mood.

It was a nice clear day, and I enjoyed the trip. I got all the eye-pictures that

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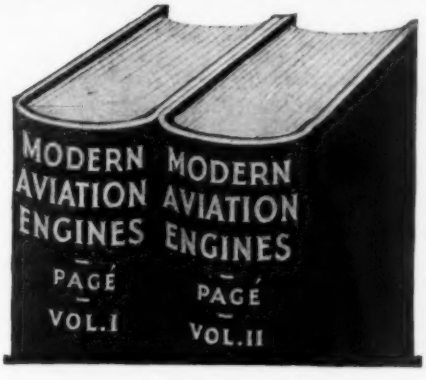

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The first thing my pilot pointed out was the Pensacola Country Club.

I suppose everyone gets, like imagining rivers to be huge dinosaurs with many feet and long tails; roof-tops to be colored squares in a patch-work quilt. I kept humming "PipAyAYYdy Ay Ay AYAY—I don't care what becomes of me. . . ." But right here I want to say that I didn't get any of the terrified reactions fashionable with movie-producers and, I understand, male aviation students.

We couldn't land in Portsmouth because there was a gully across the field, so we went back to Hampton Roads and put down there. I stayed with friends while the fair-business was transacted, and two days later returned to Washington over the same route, only this time, before I got into the plane I made sure there was something solid underfoot before I put my weight on the wing.

And so I was launched, a firm believer in the possibilities of aviation with a strong desire to trade in my car on an airplane. Captain Myers fearlessly offered to teach me to fly, but there mother firmly drew the line. However, I was a staunch enthusiast, and my feature article was so well accepted by the city editor that I decided to try my hand at free-lance aviation articles. So for three years I toiled away, writing about air races, wind-tunnels, parachutes, air-mapping, and a myriad other flight subjects, of course, under a masculine pseudonym, for what editor thought a woman knew anything about flying at that time? I couldn't fly, but it was only because I hadn't had an opportunity. What more natural than marrying an aviator?

In the meantime, Lindbergh was paving the way for public acceptance of aviation. With this in view, he came to Washington and invited all of Congress to fly with him. There were two planes at Bolling Field—both cabin-type, one belonging to the Army, the other to the Navy—and for three days the famous airman took up his guests, alternating between the two planes with less than five minutes between flights. I remember that flight as a slight damper to my enthusiasm. It was too much like riding in an expensive limousine. Then and there I decided that an open plane was infinitely to be preferred.

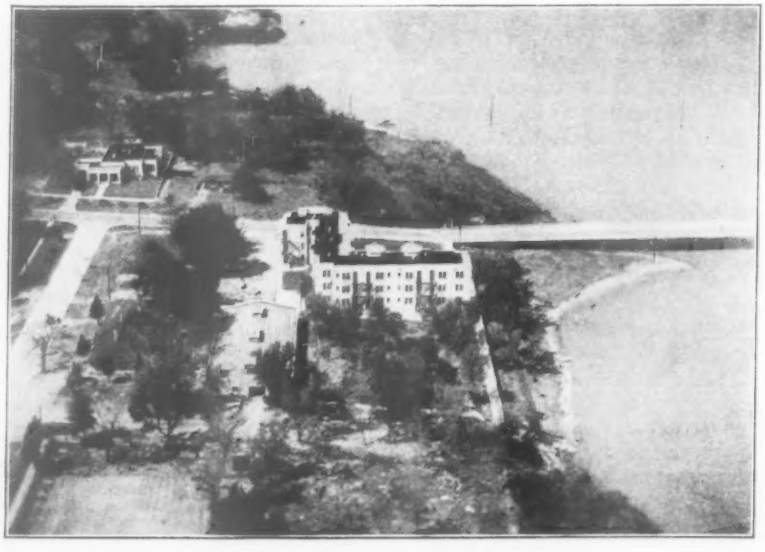
While this isn't intended to be a treatise on egotism, I must admit that writing, talking and living aviation gave me a sort of superior knowledge of airplanes and their antics. I read the ground school manuals of the Naval Aviation Training Course and felt competent to take a plane up and come down safely. Then my husband was ordered to the Naval flight school at Pensacola, Florida.

Until I talked with student aviators I had no idea about their awe of "wings," and it took considerable obsequiousness for me to realize that an instructor is more than a lesser God in their prayer rituals. On him depends their salvation —will they pass the 200 hour course that warrants the designation of Naval Aviator. And, I believe that these boys are just as sincere in their endeavor to fly as if there were no 50 per cent increase in salary attached to the glory. They take their instruction hops as personally as if they were unique in their reactions, but any instructor will say that as a class, all students ask the same questions, do the same "bone-head" things, and get the same thrill when the instructor waves his hands to let them know he is not helping them with the controls. But ask an instructor what he thinks about women in the air, and he talks in volumes, though the less said in the vein he chooses the better, before a strictly ladylike audience. I might add that generally he knows nothing about a woman's flying ability.

About a month ago, the king-bee of instructors came to our apartment to dinner, and after the coffee, when I decided that he was in his most receptive mood, I suggested that he take me up and give me a lesson. While he still thought it was a joke, he agreed, and when he found out that I was serious, it was too late to back out. So it was that I appeared at his squadron, equipped with a Gosport helmet, leather

(Continued on page 85)

And the new apartment building was Mirador Courts, where I lived.



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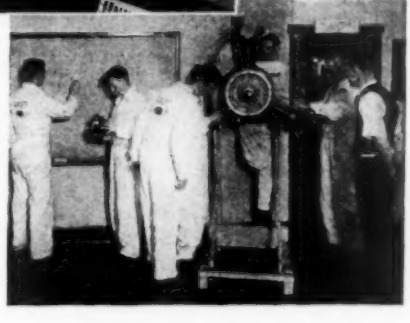

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Simple Aerodynamics

By Alexander Klemin

(Illustrations by the author)

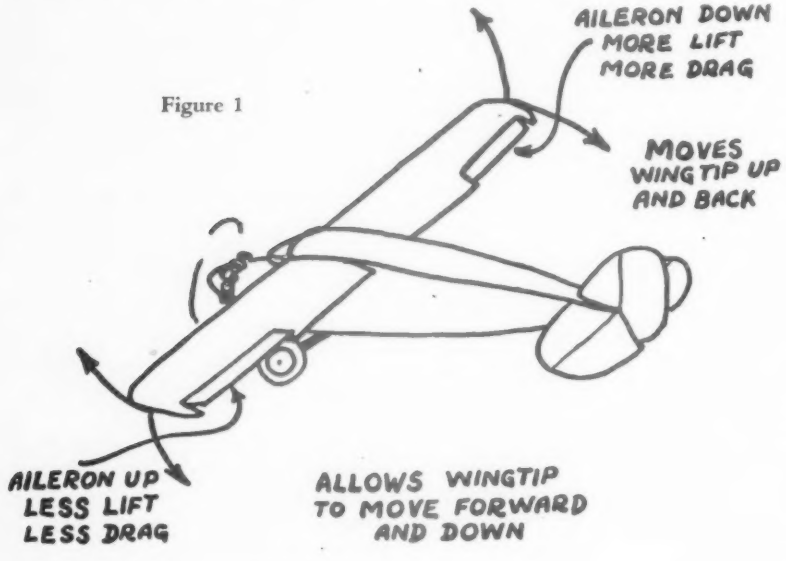
Daniel Guggenheim School of Aeronautics, New York University

Turning

THERE is one important property of the ailerons which has a bearing on the correct turn, and that is the yawing moment of the ailerons.

If the right aileron is depressed, and the left aileron is raised, there is more lift on the right side, and at the same time more drag. (This would seem to be axiomatic on the ground that where there is more lift, there is also more drag, but a sounder explanation will be given in a later article.) Hence if a machine is banked to the left by means of the ailerons, there will be a simultaneous tendency to turn the machine to the right. This is illustrated by the diagram of Fig. 1.

Figure 1



Natural Banking Moment

If a plane is turning about some center, no matter how distant, then as is shown in Fig. 2, the tip which is further away from the center of the turn is moving more rapidly than the inner tip. Therefore the outer tip has more lift than the inner tip of the wing, and the plane has what is known as a "natural" banking moment.

Starting a Turn and Staying in a Turn

We are now in a better position to discuss the whole maneuver of the turn.

Suppose the plane is flying straight and level. As stated in the previous article, there are two alternatives involved in making the turn: one is to turn at the same angle of incidence, but greater speed in which case the engine has to be opened up; the other is to increase the angle of incidence slightly and make the turn at lower speed, without opening out the engine.

Suppose we remember this rule, and wish to make a turn to the left. To turn the machine to the left, left rudder is applied. If the rudder alone were applied, then centrifugal force would make the plane skid to the right. Therefore ailerons must be used to bank the plane with left wing tip lower than the right.

For anything but the very gentlest turn, sufficient rudder must be applied not only to start the turn but also to overcome the adverse yawing tendency of the ailerons.

Suppose that when the turn is started, the stick were held at its original sidewise displacement and the ailerons in their original displaced position accordingly. Then the "natural" banking moment of the machine would come into play, and the plane would over bank.

Therefore as soon as the turn is well started, the ailerons should be eased off.

But if the ailerons are eased off, their "adverse" yawing moment disappears. Hence the rudder must be eased off likewise.

It might be thought that once a steady turn is reached, the rudder could be straightened out completely. This is not the case, because the plane always opposes turning. The outer wing tip turning faster than the inner wing tip has

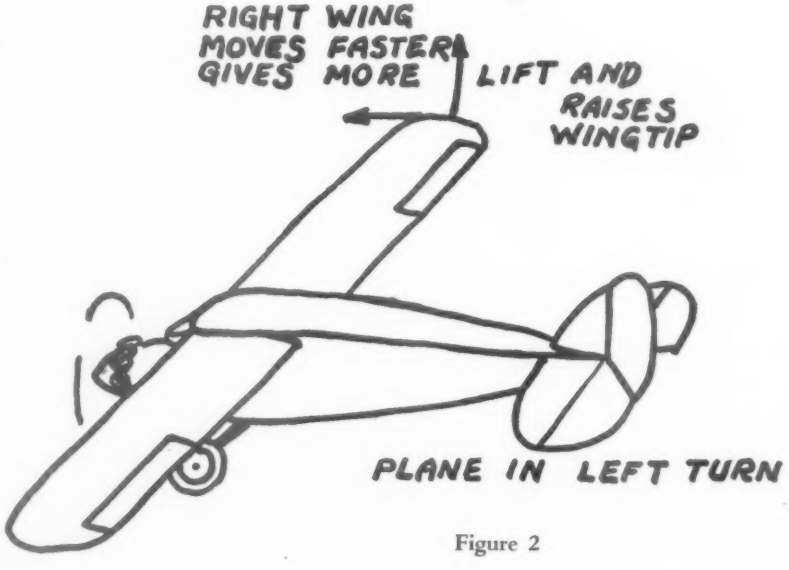


Figure 2

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not only more lift but also more drag. The fuselage, the vertical fin, every exposed part of the airplane, continues to oppose the turn. Therefore throughout the turn, steady pressure has to be applied to the rudder bar.

It is probable also that the ailerons will have to be displaced slightly for some planes in a direction opposite to the original displacement so as to counteract the "natural" bank of the wings.

Let us see next whether the elevator has any part to play in the turn.

We stated that if on the turn, the engine is not let out, the angle of incidence must be increased and the air speed decreased. This can be accomplished by pulling back on the stick. But the stick must not be pulled back too violently before the turn is started, for otherwise the plane will begin to climb, or there may even result a loop somewhere between the vertical and horizontal.

Again, the rudder always turns the plane about the normal axis of the plane. In level flight, this axis is vertical. In turning the plane is banked, and this axis is inclined sidewise. Hence the rudder tends to turn the nose of the plane downward as illustrated by Fig. 3. If the turn is to be performed in a horizontal plane, this tendency of the nose to drop must be resisted by a slight backward pull on the elevator.

The backward pull on the stick must not be too great, or else there will be a disposition to a climbing turn. It is not certain that the machine will have sufficient power for a climbing turn. Certainly the beginner should not attempt a climbing turn, for a stall and a subsequent spin may follow. Any tendency of the nose to rise above the horizon should be checked therefore by easing the stick forward.

We can easily explain the process of coming out of the turn.

To remove the bank, we must apply left aileron. This introduces again the adverse yawing moment which tries to continue the turn. Therefore simultaneously with the left aileron, sufficient right rudder must be applied. Also the stick must be pushed forward, because right rudder on a left bank causes the nose to rise. When the wings are level, the ailerons are neutralized, and rudder is brought back to normal.

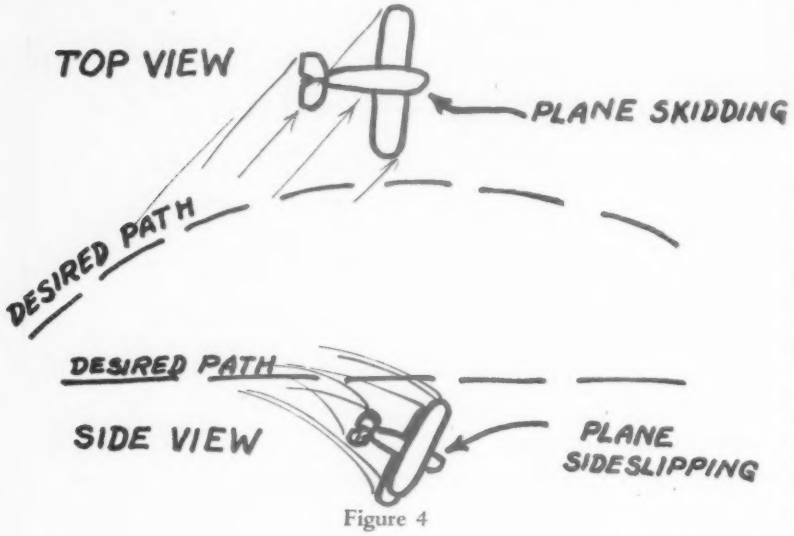


Figure 4

Simple Rules for the Turn

We have tried to make this explanation of turning as simple as possible. It may nevertheless be puzzling. The arm chair aviator has plenty of time to explain any maneuver. The practical flyer should understand the underlying principles of a maneuver if possible, but he should also have simple rules at his command, memorized in ground school, practiced in the air, until their application becomes instinctive.

Such rules are given in the manuals of the Army and Navy, and in the excellent pamphlets issued by private schools. They read somewhat as follows below. It will be an excellent exercise for the reader to check the correctness of these rules in the light of our theoretical discussion:

1. To make a left turn, apply left bank and ample left rudder together.
2. If engine is not let out, when turn is begun, pull stick back gently.
3. When desired bank is reached, ease off ailerons and rudder.
4. Keep nose level throughout the turn. To make horizontal turn, use both rudder and elevator.
5. Maintain same degree of bank and constant pressure on rudder throughout the turn.
6. To come out of the turn, apply right aileron and right rudder.
7. When wings are level, neutralize ailerons, then put rudder in normal position.

Slips and Skids

A side-slip is generally defined as a movement of the plane towards the depressed wing tip and occurs of course when the centrifugal force is not large enough for the bank. A practical warning of the side slip is wind blowing from the inner or lower side of the plane on the face. Side slip can be readily eliminated by using a little more rudder.

A skid occurs when the lift in the bank is insufficient to balance the centrifugal force, and the warning signal is a wind from the outer or high side of the face. Easing the pressure on the rudder is the obvious remedy; the alternative is to increase the bank.

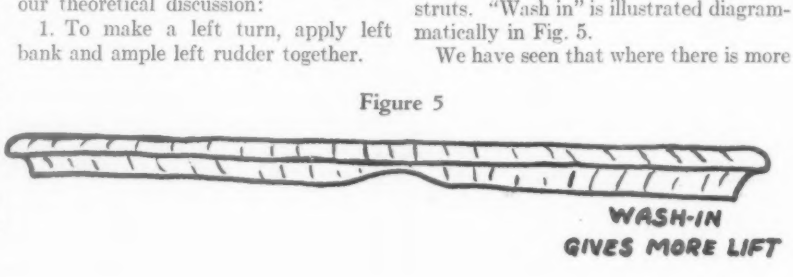
The side-slip and skid are illustrated in Fig. 4.

Engine Torque Effects

Action and reaction are equal and opposite. Therefore if the engine applies a torque to the propeller which it is turning, then the engine must be tending to turn the airplane in the opposite direction to the rotation of the propeller. The readiest way to counteract this turning moment is by changing the rigging of the wings, so that there is more lift on one wing tip than on the other. Thus with a right hand propeller, there is a tendency to bank the plane to the left. Therefore the incidence on the left wing tip should be increased, or "washed in." Another plan is to decrease the incidence on the light tip, or use "wash out"; or the left wing tip may be slightly "washed in" and the right wing may be slightly "washed out." This change in rigging is easily made in a biplane by adjustment of the lift wires preferably in combination with adjustable interplane struts. "Wash in" is illustrated diagrammatically in Fig. 5.

We have seen that where there is more

Figure 5



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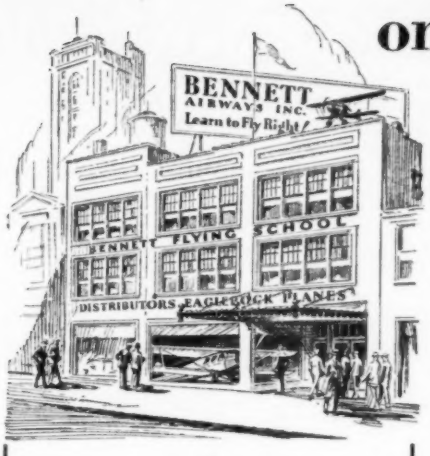

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lift, there is also more drag. If, therefore, the torque of the right-hand engine is eliminated by change in the rigging, so as to give more lift on the left wing tip, there will also be more drag on the left wing tip. A certain amount of right rudder always has to be employed, therefore. Sometimes a rubber shock absorber cord is attached to the rudder bar to relieve the pilot on a long flight. The combined effects of wash in, wash out and rudder are illustrated in Fig. 6.

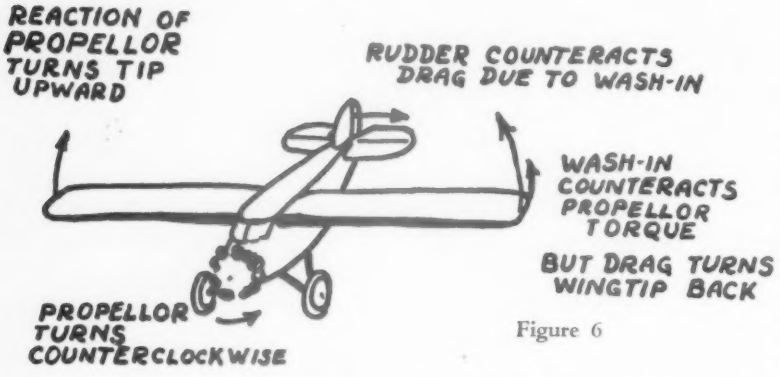

REACTION OF PROPELLOR TURNS TIP UPWARD
RUDDER COUNTERACTS DRAG DUE TO WASH-IN
WASH-IN COUNTERACTS PROPELLOR TORQUE
BUT DRAG TURNS WINGTIP BACK
PROPELLOR TURNS COUNTERCLOCKWISE

Figure 6

Apparent Changes of Control Action in Steep Banks

People often speak of "inversion of the controls" in steep banks. The controls never change their functions however steep the bank may be. The elevators will always pitch the plane about the transverse or lateral axis, the rudder will always turn the machine about the normal axis of the plane, the ailerons will always roll the plane about the longitudinal axis. But when the machine is banked steeply, then these axes of the plane no longer have their normal attitude relative to the earth. The controls will continue to function about their respective axes just as they always do, but their effect as regards the movement relative to the earth or the horizon will be different.

Suppose we consider the case of an almost vertical bank, shown in Fig. 7. This can only be made on a very powerful and very fast machine, since only a small portion of the lift is now counteracting the force of gravity. (It is the author's guess that in an almost vertical bank, lateral forces on fuselage and wings also contribute in carrying the weight of the plane.) It can be seen from this diagram that the transverse axis about which the elevator acts is now vertical. Therefore it is the elevator which is now turning the plane in the horizontal plane, about the vertical axis in space. On the other hand the normal axis about which the rudder acts is now horizontal. Therefore it is the rudder which is dipping or raising the nose of the plane. The longitudinal axis on the other hand remains horizontal and therefore the ailerons behave as they always do, acting in roll.

If the bank has any value between 0 degrees and 90 degrees, then the rudder is partially turning the plane about a truly vertical axis, partially pitching it the nose up or down about a horizontal axis in space. In the same way the elevator will partially help to turn the plane about a vertical axis in space, partially pitch it about a horizontal axis in space.

The reader will find it a pleasurable exercise in imagination to visualize the preceding paragraph.

Problems

1. If the rate of turn is too slow for the angle of bank, what will the airplane do? What should then be done with control stick and rudder?

2. If the rate of turn is too fast for the angle of bank, what will the airplane do? What should then be done with control stick and rudder?

3. If the rudder is put on before the airplane begins to bank, what will happen? What is the remedy?

4. If too much elevator is applied at the beginning of the turn, what is likely to happen?

5. If too much rudder is applied after the turn has developed, what will happen?

6. If too little elevator is used after the turn has developed, what will happen? What is the remedy?

7. If there is too much elevator what will happen?

8. Explain the following extract from the British Flying Training Manual:

"In order to come out of a turn, considerable effort is required for sufficient application of the ailerons when taking off the bank. Full opposite aileron should be firmly applied, otherwise the aeroplane will be slow to respond. If top rudder is put on too soon, the aeroplane side-slips; if it is put on too late, it is slow in coming out of the turn and the pilot will be not facing the point of horizon at which he was aiming. Failing to centralize the rudder at the correct time will cause the aeroplane to skid."

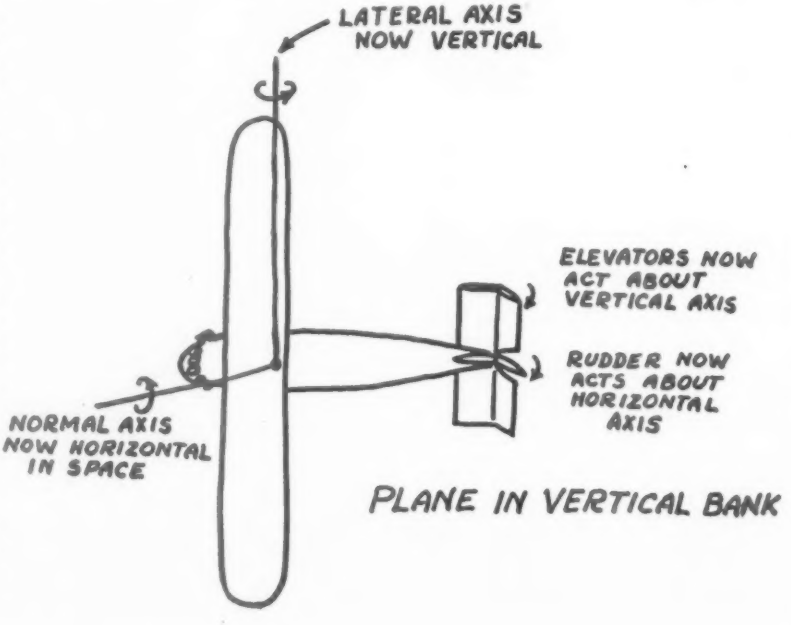
9. What will happen if the wing is not checked when the proper bank is reached?

10. The student feels a considerable slip. Should he discontinue the turn and if so, why? What may be the effects of a serious skid?

11. Should ailerons be used on a very steep, steady turn?

12. The British Flying Training Man-

Figure 7. (Figure 3 is a modification of this and is left out as an exercise for the reader)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RUDDER NOW ACTS ABOUT HORIZONTAL AXIS
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ual gives the following instructions for a steep turn.

(I) Commence as for an ordinary wide turn, but the bank must be increased by firm application of the aileron control.

(II) A little rudder should be first applied towards the direction of the turn, but as the bank increases the rudder must be adjusted to keep the nose on the horizon.

(III) At the commencement of the turn, the elevator should be used to keep the nose from falling, but as the bank increases the control column should be pulled further and further back to keep the airplane turning in the horizontal plane.

Comment on these instructions.

Answers

1. If the rate of turn is too slow for the angle of bank, the plane will sideslip towards the depressed wing, because there is not enough centrifugal force to balance. The remedy is to give more rudder (which is sometimes termed giving bottom rudder). If the bank is steep, the rudder may then act in such a fashion as to depress the nose. Therefore it may also be necessary to pull the stick back a trifle.

2. If the rate of turn is too fast, the plane will skid out. Bottom rudder should be eased off. If the bank is steep, then the same effect may be obtained by easing the control column forward.

3. If the rudder is put on before the airplane begins to bank, the plane will skid out. The remedy is to reduce the amount of rudder or increase the bank.

4. If the stick is pulled too far back at the beginning of the turn, there may ensue a climbing turn which is not advisable for a beginner, nor on any but powerful machines. Or the machine may do a loop about some axis between the vertical and the horizontal.

5. Too much rudder after the turn has developed, will cause a skid outwards, and the machine will be at an angle to its flight path.

6. If too little elevator is used after the turn has developed, particularly if the turn is a steep one, the airplane will slip inwards (because the elevator has practically the property of a rudder). The remedy is more elevator to hasten the turn or less bank.

7. If too much elevator is used for steep turning, while at the same time there is not enough bottom rudder to keep the nose up, the nose will drop and the airplane will ultimately spin.

8. Answer is left out, as a special problem for the reader.

9. When the proper bank is reached, the wing supplies a "natural" banking moment. Hence if wing is not checked by the ailerons, an overbank will result leading to a tight spiral or a spin.

10. If the slip is considerable, it is safer to discontinue the turn. If slipping is towards the left, right rudder and left aileron should be used for a short time. At the same time the nose is dropped to insure adequate speed. After the neutralizing process the plane will be on a course to the right of that before the slip.

11. Ailerons are not needed on a steep, steady turn since both wing tips are then moving with approximately the same speed, and there is no "natural" banking moment.

12. The answer is left out, as a special problem to the student.

What's Doing in Washington

(Continued from page 30)

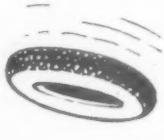
all kinds, bankers, storekeepers, lumber manufacturers, railway executives, all talk of aeronautics on the slightest provocation. At a dinner I sat beside the president of a prominent tool manufacturing concern and I tried hard to get him to talk about his company but he would only talk of the money to be made in the stocks of aircraft companies.

A committee of the National Chamber which has followed the course of aeronautical development submitted a report to the Annual Meeting of the Chamber. As a result the meeting went on record as follows:

"Air transportation is essentially national in scope. State legislatures are urged to have interstate rather than merely intrastate service in mind for their citizens when drafting aeronautical legislation and member organizations are urged to support this principle.

"Uniformity of aeronautical legislation is necessary and it is important that in enacting such legislation the states should conform their laws and regulations to those of the federal government.

"The establishment of airports is essential to the proper expansion of air transportation. Appropriate legislation should be enacted to enable the states, municipalities and counties to appropriate funds and acquire lands for the practical development of aeronautics through the establishment of airports and the encouragement of the use of aircraft."



NOTHING that government experts have produced in a long time has attracted the interest of the aircraft industry as much as the process of cooling airplane motors by use of ethylene glycol developed by the Aeronautical Laboratory. Representatives of manufacturers are on the job and preparing to take full advantage of the new fluid and signs point to important announcements from headquarters of aircraft makers.

Likewise notable results are looked for from the new type of internal combustion engine recently tested with great secrecy at the Naval Aircraft Factory in Philadelphia.

The number of men in Washington who make a living out of aeronautics is increasing. Aside from the technical men who serve the government there are specialists who write aeronautical features for the newspapers, investigators who supply New York stock brokers with inside investment news, and representatives of aeronautical companies who find it necessary to note every move of official Washington. Most every day one can see in the lobby or dining room of the Carlton Hotel key men in the aviation world, here for a day or a week. This hotel, by the way, has become something of an aeronautical center. One of its distinguished permanent residents is Col. Paul Henderson. The Washington aeronautical club has its headquarters there.

THE Department of Commerce seems to be having its troubles in rating flying schools in accordance with the law Congress passed this year. New schools are being started so fast it is hard to keep track of them. Ratings are to be made upon request of the schools themselves and those that are well established are quick to see the prestige to be gained from having a certificate from the federal government attesting the excellence of the school. The Department, however, is short of money and personnel to do this job and, therefore, it is difficult to avoid dissatisfaction on the part of those that may be unable quickly to get an official rating.

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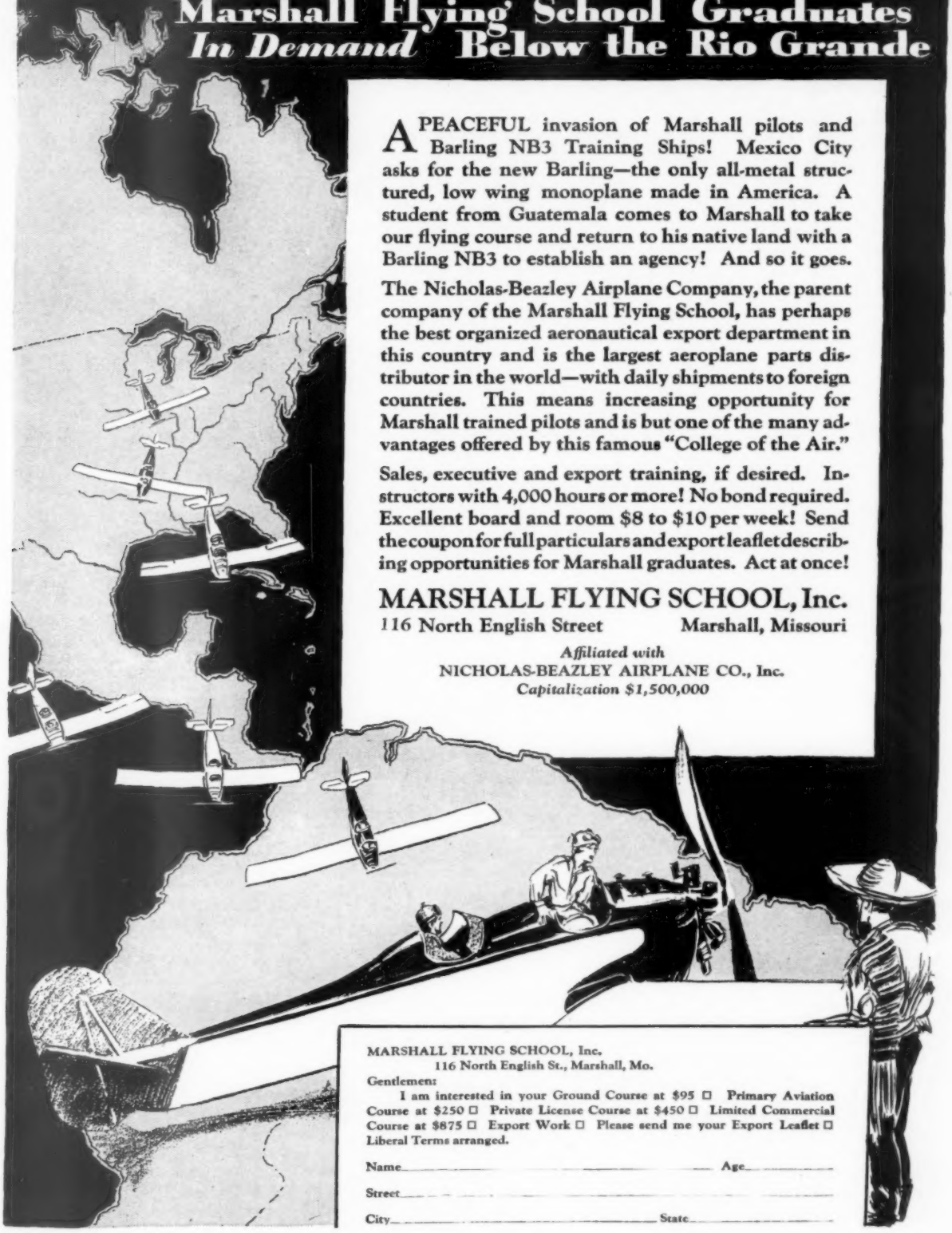

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Sky Pilotage

By Commander Douglas G. Jeffrey
Royal Naval Reserve

PROBABLY the most important factors in the understanding of navigation, be it Aerial or Marine, are a thorough grasp of time and the use of the nautical almanac, or its aerial equivalent. Anything as intangible as "time" may prove difficult to grasp; but until we have got hold of it Sky Pilotage must remain a closed book.

The Book of Isaiah speaks of "the sundial of Ahaz," and it is claimed that the Chinese had a twelve month year, as far back as 2255 B. C. A Mayan calendar was invented in 613 B. C., which actually dated the creation as October 14th, 3373 B. C., and the Aztec calendar, probably the oldest on the American continent, shows months of twenty days and weeks of five days each.

The earliest recorded measures of time were sticks tied in bundles, each stick representing the period between sunrise and sunset and each bundle of thirty sticks representing a moon; these ancients having noticed that the moon changed from full to full every thirty days (actually twenty-nine and a half days). The Indians of the Canadian North West still use this method.

Very early records show a five bundle year and the patriarch Abraham gets the credit of introducing a six bundle year. The Romans appear to have been content with a five bundle year, until Romulus got busy and increased it to ten. Later this was increased by Numa to a twelve month year, and finally the efforts first of Julius Cæsar and in 1582 the modification made by Pope Gregory the Thirteenth, gave us the Gregorian Calendar as we know it today.

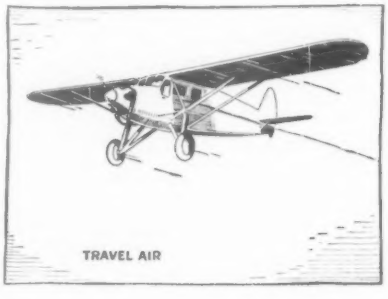
Tomorrow—Quien Sabe? Chicago business men met only a few weeks ago to discuss a thirteen month year, and Lord Birkenhead writes in an up to date magazine article of the possibility of modifying the action of the tides; thus retarding the rotation of the earth and giving the world a forty-eight hour day.

Early navigators appear to have worried very little about longitude as we know it today; being content with a moon sight (meridian altitude) for determining latitude, longitude remaining merely a matter of dead-reckoning. The situation came to the notice of Phillip III of Spain, and in 1598 he offered 6,000 ducats for an efficient method of determining longitude—with no result. The records of Capt. Fox (North West Passage in 1631) state that he carried "a watch clock 6 inches in diameter, and a lesser watch" presumably for navigation purposes. The Dutch claim that the first use of spring driven clocks for navigation purposes, was made by Huyghens in 1660-1670. These were pendulum controlled clocks and were only useful in a dead calm.

The navigational chronometer as we know it today, owes its origin to the enterprise, somewhat belated to be true, of the Admiralty, who in 1713 offered three prizes of £10,000, £15,000 and £20,000 for an efficient marine chronometer. The conditions of the award were that the chronometer should at the end of a six weeks voyage, enable the longitude to be computed within 60, 40 and 20 minutes respectively. This offer aroused the interest of John Harrison, a carpenter, and from 1728 until 1761, Harrison and his son worked persistently on the problem.

Eventually (1761) William Harrison, the son, embarked on board H. M. S. Deptford, outward bound for Madeira, with the first real navigational chronometer. As the voyage progressed and the time for making Madeira approached, the difference between the dead reckoning position and that by chronometer so alarmed the captain of the Deptford that he was inclined to entirely discredit Harrison and his clock and trust in "Latitude, Log, Lead and Lookout" which summed up the navigation of the period. Harrison, however, stood to his guns and stoutly maintained that if Madeira was where it was shown on the chart, the landfall would be made right ahead, and so it was.

If the dead reckoning position had been accepted the Deptford would have missed Madeira altogether; "the consequences of which," to quote a contemporary record, "would have been inconvenient, as they were in want of beer." It is possible, and this is not an anti-Volstead argument, that the old seadog in command of the Deptford may have been influenced in his recommendations to "their Lord Commissioners for Executing the Office of Lord High Admiral," by the fact that Harrison assisted in the prompt supplying of this "want." It is interesting to note that the four original Harrison chronometers have recently been cleaned and repaired under the supervision of Lieut.-Commander Gould, R. N. and are now ticking merrily away in Whitehall. Harrison did not receive his cheque until 1773, three years before his death and then only after a petition to Parliament. Apparently government methods do not change.



As the importance of navigation dawns on aviators, a real chronometer will become a piece of every day equipment. It has been argued, that the great speed of aircraft will obviate the necessity for carrying chronometers. The contrary is the case; the speed will render them all important. In addition to the usual care and attention required by a chronometer, which is described in any standard work on navigation; particular attention will, in the case of aircraft, have to be paid to "temperature rate." As the result of testing over two thousand watches at the Liverpool Observatory, the following rules, known as Hartnups' Laws were promulgated:

(1) Every chronometer goes fastest (i.e. gains most or loses least) in some temperature, which has to be calculated for each chronometer from the rates that it makes in the three fixed temperatures; the temperatures used in the Liverpool Observatory for testing watches being 55, 70, and 85 Fahrenheit during the winter and 65, 75, and 85 during the summer.

(2) As the temperature varies, either increasing or decreasing from that in which the watch goes fastest, the watch goes slower; and its rate varies in the ratio of the square of the distance in degrees of temperature, from its maximum gaining temperature. For example, if a watch goes fastest in temperature 75, it will go slower as the temperature either rises or falls below 75; and it will go slower by the same amount in any two temperatures that are the same distance from 75, one being above and the other below, as in 65, and 85—one being 10 below and the other 10 above 75.

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The importance of a knowledge of these facts in using chronometers in aircraft is obvious, the changes of temperature being much more frequent and sudden than is possible under marine conditions.

So much for the chronometer. Once the chronometer was made available the Nautical Almanac followed. There are two editions issued in the United States; viz., The American Ephemeris and Nautical Almanac and The Nautical Almanac. In Great Britain the volume corresponding to the American Nautical Almanac is entitled The Nautical Almanac (Abridged for the Use of Seamen). What is required is an almanac "abridged for the use of airmen" and it is probable that 1929 will see its production together with an abridged and modified set of logarithmic tables for the same purpose.

The various denominations and standards employed since the dawn of astronomy with the exception of the month, have invariably been based on the time necessary for a complete revolution of the earth around the sun, and by the rotation of the earth round its own axis. The first represents the year, and the latter the day. Hours, minutes and seconds are all based on the above; the month however, one twelfth of a year, (at present), is based on the revolution of the moon round the earth.

In aerial astronomy, two kinds of time are used; solar time and sidereal time. Solar time is measured by the apparent diurnal motion of the sun, which for convenience is assumed to revolve round the earth; although in reality the reverse is the case. All this may seem very elementary; but to utilize celestial fixes intelligently, one must "grasp" time. Time varies on each meridian in accordance with the meridian's position relative to the sun. To get a globe and revolve it is the simplest way to refresh the memory on this point. On any meridian westward of the sun it is forenoon, and on any meridian eastward it is afternoon.

The sun is not actually a very accurate timekeeper, and although Ahaz may have been content with his sundial, time was not so valuable then as now. The sun is in fact so irregular that no chronometer could be constructed to compete with it. This is due to the non-coincidence of the ecliptic with the celestial equator, combined with what is known as the eccentricity of the orbit. The apparent sun proved so irregular the astronomers got busy and devised an imaginary sun, which they assumed travelled along the celestial equator at a uniform speed: i.e., with exactly 24 hours between its transits from one meridian back to the same meridian, this period being the average or mean of all the apparent sun days in one year. This device gives us the mean solar day and the mean sun. This is the time that is used everywhere for navigational and work-a-day purposes.

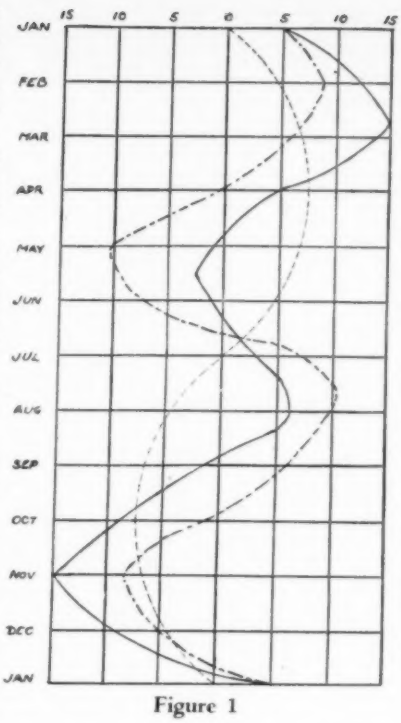


Figure 1

To facilitate our celestial fixes, however, we need what is known as sidereal time; which is based on the apparent diurnal revolution of the stars that results from the rotation of the earth. A sidereal day is equal to 23 hrs. 56 mins. 4 sec. of mean time. The revolution of the stars may be taken as perfectly regular, because their distance from us is so great.

The foregoing should have made clear just what apparent solar day (apparent time) and mean solar day (mean time) and sidereal day (sidereal time) represent. Sidereal time is in fact, the basis of all time; but it is not convenient for everyday use, as its noon pays no regard to light or darkness; so it is converted into solar time and is the standard for the clocks throughout the world.

One outstanding difference between the methods of computing solar time and sidereal time is the fact that while with the former the sun is a point of reference with the latter a sort of imaginary datum mark and not a star is point of reference. This celestial "bench mark" is shown to navigators as the First Point of Aries, and is the spot where the ecliptic and the celestial equator coincide when the sun's declination changes from south to north, namely at the vernal equinox. There is also another "bench mark" known as the First Point of Libra, corresponding to the point where the sun's declination changes from north to south—the autumnal equinox. This latter point does not concern us very much. When the astronomers first decided on these points the vernal equinox happened to coincide with the constellation of Aries, and the autumnal equinox with that of Libra.

The names have clung with great tenacity, despite the fact that over 2,000 years ago Mr. Hipparchus discovered that the "bench marks" were on the move. Today the First Point of Aries is leaving the constellation of Pisces for that of Aquarius and the First Point of Libra is leaving Virgo for Leo, both having travelled 30 degrees in the last 2,000 years. It will take approximately 26,000 years for Aries and Libra to complete the grand tour and get back home again; so why worry?

It is from this wandering jew of a bench mark that the right ascensions of heavenly bodies are calculated. Right ascension of a celestial body corresponds to longitude and declination to latitude when compared with things terrestrial.

The following comparative arrangement may be helpful:

Terrestrial		*Celestial*
Latitude	=	Declination
Longitude	=	Right Ascension
Greenwich Meridian Zero	=	First Point of Aries Zero for Right Ascension.

Right ascension may be defined as the arc of the celestial equator between the First Point of Aries and the meridian of the body it refers to. It is reckoned in exactly the same way as longitude but is expressed in hours and minutes from west to east, counting twenty-four hours in all. The First Point of Aries parallels the meridian of Greenwich, as is shown above. The zero meridian for longitude like the First Point of Aries has not always been where it is today but it has moved from quite different causes. In the early days when longitude was not regarded as of great importance a constant comparison mark was not felt to be a necessity, and the Zero Meridian was placed in various geographical positions. In 1673 it was in Teneriffe, in 1720 the Island of Ferro; but since 1723 the meridian of Greenwich has been generally accepted. Some of our South American neighbors still use a local zero meridian for their local maps. The French for long resisted the capture of the first meridian by "perfidious Albion," and at the final conference the French representative was the only dissentient. Some French maps still show the zero meridian at Paris.

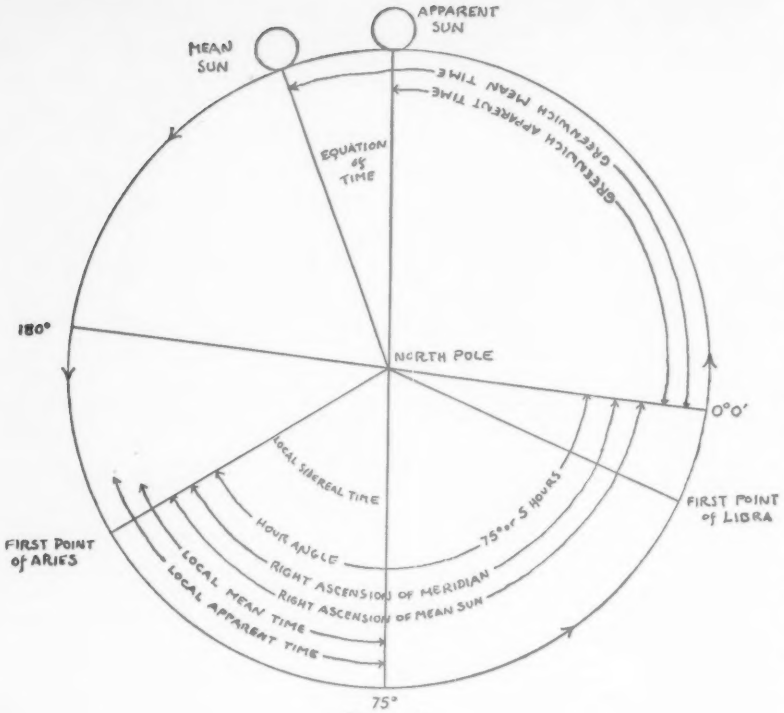


Figure 2

We have now dealt with solar time, sidereal time, the First Point of Aries, declination and right ascension. Before we can compute our celestial fixes we must become acquainted with two more time factors, the equation of time and the hour angle. The hour angle of a celestial body is the angle formed at the pole, between the meridian and the hour circle passing through the body, measured westward.

For a definition of the equation of time we must hark back a little, and remember that the apparent orbit of the sun is actually due to the earth's revolution around the sun; and that for convenience it is considered to be the revolution of the sun around the earth. This seems somewhat like the old navy story concerning the ammunition boxes. A modification to a certain type of ammunition box made it more convenient to open the box from the bottom than from the top. To facilitate things the Admiralty issued a label for these boxes which stated in bold red type "In order to avoid confusion the bottom of this case is marked top." In the consideration of celo navigation the arrangement outlined above, once it is really understood, does simplify and facilitate our calculations and actually "avoids confusion."

Secondly we must remember that the movement of the real sun is not regular, hence our mean sun with its uniform rate. The equation of time is the difference between the two. At times these two suns coincide and at other times they are as much as 16 min. and 20 secs. apart; sometimes one is ahead, sometimes it is astern—an ever varying equation. This irregularity of motion is due to the fact that the earth travels in an eclipse and also varies its distance from the sun and in so doing increases its normal speed in December and January and decreases it in June and July. A study of Kepler's Law will help the student; but space will not permit of such a digression here.

There is a further component part of the equation of time, namely, that due to the obliquity of the orbit, and this is somewhat easier to understand. It is introduced by the fact that the apparent sun moves in the ecliptic while our imaginary "mean" sun is supposed to move along the celestial equator. (Fig. 2.) Only on four occasions during a year do the two suns "get together," at the equinoxes and the solstices.

A summary of the above gives us something like this:

Error due to Eccentricity of Orbit—The apparent sun is ahead of the mean sun from December 31st to June 30th, and has a maximum lead about April 1st. The apparent sun then falls astern until December, its maximum "lag" being 8 minutes on October 1st.

Error due to Obliquity of Orbit—Is cumulative between the equinoxes and solstices. The two suns are together on these four points and there is no error. In May, August, November and February the error reaches a maximum of 10 minutes. In August and February the mean sun "takes station ahead."

Eccentricity + obliquity = equation of time.

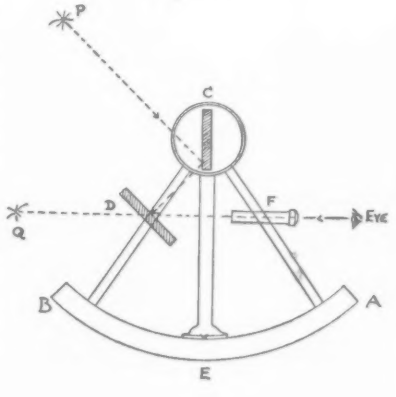
We may now consider the question of time as being all cleared up and I hope it is. The Nautical Almanac or rather that part of it that concerns the aero navigator is merely a time table for the foregoing movements and if they are understood the almanac is self explanatory. We can now consider observations and fixes and the most suitable methods of obtaining them.

It is not so very long ago, certainly not less recently than the early part of the nineteenth century that navigators depended solely on latitude by meridian altitude for taking ships on voyages from "China to Peru" and even farther, longitude as mentioned above being merely a matter of dead reckoning. Meridian altitude observations still play a part in modern navigation and a brief consideration of this problem will facilitate the consideration of more up to date methods. To determine latitude by meridian altitude we require three main factors (a) altitude of celestial body (b) zenith distance (c) declination. The altitude is obtained by observation by sextant. The zenith distance is found by calculation using altitude corrected for (1) index error (2) semidiameter (3) refraction (4) dip (5) parallax. Much paper could be covered in writing up these five corrections but Table 46 in Bowditch gives them with the exception of index error, in a combined form by inspection alone. For this reason the briefest possible description of them will suffice here.

Index error is an error more or less inherent in every sextant. There are various simple methods of checking this and a careful navigator always knows the error of his own instrument.

"Let AB be the limb or graduated arc of a portion of a circle 60 in extent, but divided into 120 equal parts. On the radius CB let a silvered plane glass D be fixed at right angles to the plane of the circle, and on the movable radius CE let another such silvered glass C be fixed.

Figure 3



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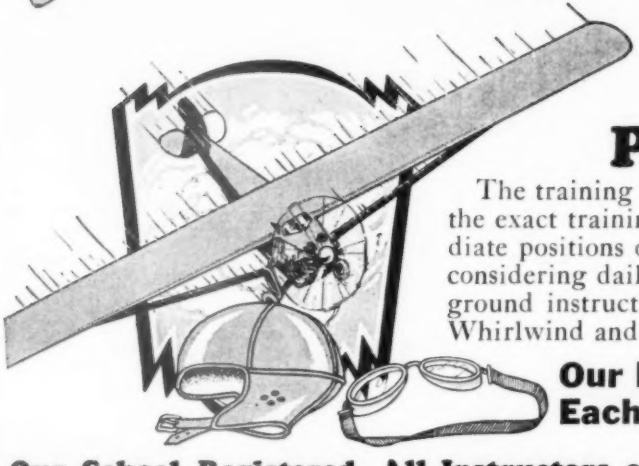

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"The horizon glass D is fixed permanently parallel to AC, and only half of it is silvered, allowing objects to be seen through it.

"The index glass C is wholly silvered, and its plane is parallel to the length of the movable radius CE, at the extremity (E) of which a vernier is placed to read off the divisions on the arc. On the radius AC is set a telescope F, through which any object Q may be seen by direct rays which pass through the unsilvered portion of the glass D, while another object P is seen through the same telescope by rays which, after reflection at C, have been thrown upon the silvered part of D, and thence directed by a second reflection into the telescope.

"The two images so formed will both be seen in the field of view at once,

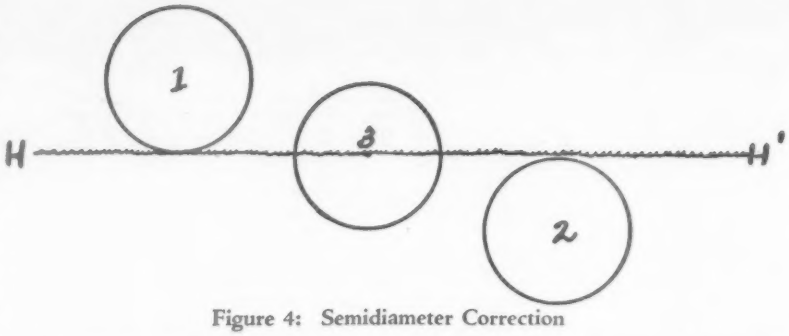


Figure 4: Semidiameter Correction

The principles of the sextant are as is generally known based on double reflection, which permits of half a degree of arc being numbered as and considered as a whole degree. Thus the sextant which is really an arc of 60 is divided into 120 equal parts, each of which do duty as a degree. The optical law governing this reads as follows: "If a ray of light suffers two successive reflections in the same plane by two plane mirrors the angle between the first and last direction of the ray is twice the angle of the mirrors." Figure No. 3 gives a good idea of this principle.

The ordinary sextant is constructed for use with a sea horizon or with an artificial horizon. There are various types of artificial horizons, all based on the law of catoptrics which states that "the angle of reflection is equal to the angle of incidence." One of the most common forms of artificial horizon is a shallow trough about 4 inches in length containing pure quick silver. No further description is necessary to assure the student that this form of horizon is not suitable for aviation use. The horizon being frequently not visible when aloft various types of bubble sextant have been devised to overcome this difficulty. There is also the Baker cloud horizon sextant that utilizes a "cloud horizon" and under certain circumstances excellent results have been attained.

So much for the sextant and index error. The remaining corrections are practically self explanatory. Semidiameter is exactly what the name says it is —the distance from centre to the circumference of a heavenly body. In measuring the altitude of celestial bodies above the horizon it is necessary to determine the distance of the *centre* of the body above the horizon. To accomplish this an edge of the body, referred to as a "limb," is brought down to the horizon and semidiameter is applied to this altitude. This is plus when the lower and minus when the upper limb is used.

Semidiameter of the sun is obtained readily from the Nautical Almanac for each ten day period. This correction varies with the distance of the sun from the earth. In January when the earth and sun are at their nearest point the semidiameter is 16° 17′ 90″, while in July when the sun is most remote from the earth this is only 15° 45′ 69″—a difference of 32′.

Refraction is just refraction and presents no difficulties. Every one knows that refraction is caused by rays of light passing from a thin medium to a denser

(Continued on page 88)

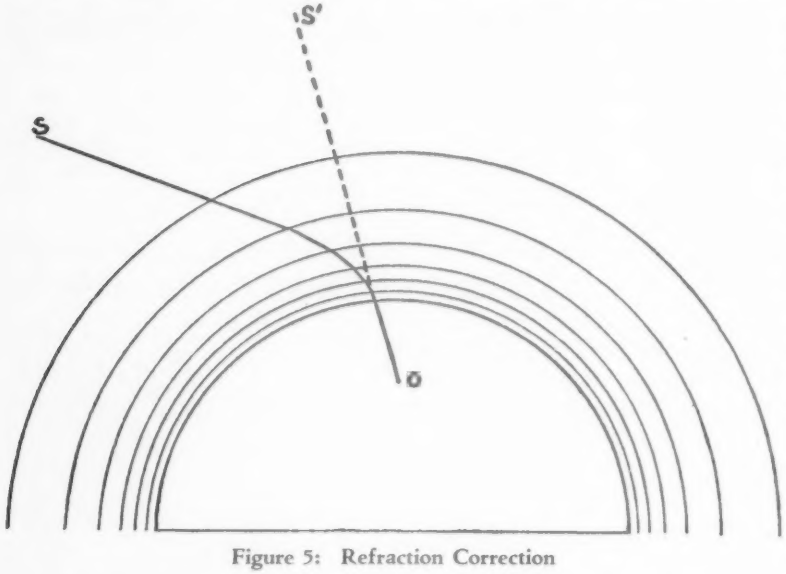


Figure 5: Refraction Correction

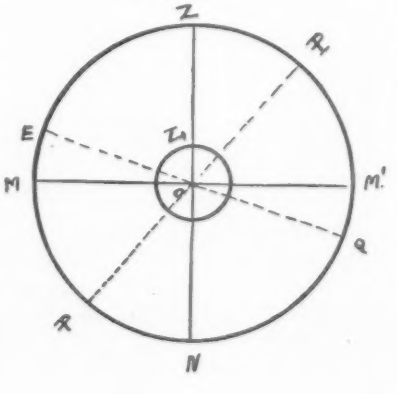
and by moving the radius CE will (if the reflection be truly perpendicular to the plane of the circle) meet and pass over without obscuring each other.

"The motion, however, is arrested when they meet, and at this point the angle included between the direction CB of one object and FQ of the other, is twice the angle ECA, included between the fixed and movable radii CA, CE.

"Now the graduations of the limb being made only half so as to correspond to degrees of arc AE, when read off as if they were whole degrees of arc, will in fact read double its real amount and therefore the numbers read off will express, not the angle ECA but its double, which is the actual angle subtended by the objects." (Lecky's Wrinkles.)

The author of Lecky's Wrinkles in Navigation has said "You should never lend anyone your horse, your gun, your dog or your sextant." Better advice was never given.

Figure 6



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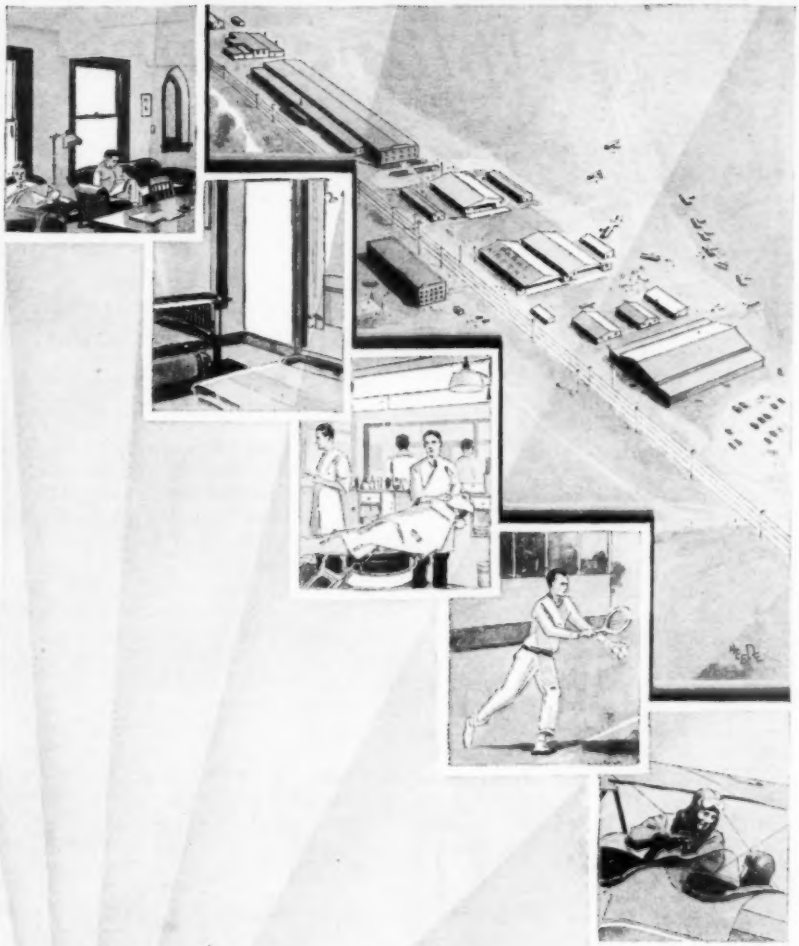

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Sailplane Construction

By Alfried Gymnich

Author of Der Gleit- und Segelflugzeugbau, Pilot, Luft Hansa, Germany

Translated by John H. D. Blanke

The construction of the wings is completed in this article.

THE framework of the supporting wings has now been completed, and we start now to separate the transversal rudders or ailerons for the supporting wings. This is done by sawing through the ribs between the beam girths of the transversal rudder and the rim bends and by cutting out the piece of rib girth, located between the two lower beam girths of the transversal rudder, as shown by the dotted line in the drawings given in the last installment. In thus cutting off the transversal rudder, one should be careful that the connecting points do not tear open or break off.

After this work, the straps of plywood (9) of the beams of the transversal rudders are glued to the girth, just as this is shown in the drawing in the last installment. The segments of the transversal rudders (11) are cut from spruce, and plywood is glued to them on both sides, so that their total thickness becomes 5/8 inch. The shape which is indicated, must be copied exactly, for otherwise a dead action or a tension in the control cables is not to be avoided,—a defect which cannot be eliminated later without great difficulty. As shown in the drawing, the connecting line of the attacking or action points of the cable must pass as a straight line through the hinge joint. If this is not the case, tensions in the control cables cannot be avoided. Therefore, particular carefulness is required here. Furthermore, attention is called here to the fact that the lever arms on the rudders and on the control must be of the same size, if an exact motion of the rudders is to be attained. In the building of our present schooling sailplane the lever arms were selected to be 3¾ inches long between the hinge joint and the action point or connection of the cable, and this distance must be maintained with great accuracy. At the mentioned points, holes are drilled into the segments for attaching the control cables, through which fitting small pieces of copper tubing are driven and then riveted over at both ends. The hollow rivets made in this manner serve, so to speak, as a bushing and prevent the breaking out of the drilled holes, which is otherwise unavoidable, due to the constant friction in actuating the rudders. The gluing in of these rudder segments must, of course, be done very carefully, for they must take up the entire air force developed in actuating the rudders. As everywhere else the gluing-in is done by aid of corner blocks and by pressure under a clamp.

Now the fittings, as indicated in the drawings and in the list of materials, are prepared; or they are ordered made if one does not understand how to work metal, or one does not have available the special tools required for this work. The fittings have been kept as simple as possible in order to facilitate the design and construction by the builder. When not indicated otherwise, all fittings are fastened with steel bolts, 3/16 inch thick; however, 5/16 inch steel bolts are used as connecting bolts between the supporting wings and the stays or the struts, or supporting wings and fuselage framework. It is advisable to safeguard all bolts, after the fittings have been mounted, by means of a thin wire, or, if bolts with a perforation at the threaded end are used, by means of a key, so that no loosening of the fitting can occur later on. Self-evidently not the slightest room for play dare be present, for the strength of the entire construction depends upon absolutely rigid connections. The safeguarding of the bolts is even more important, inasmuch as most of the bolts are no longer accessible after the supporting wings have been covered with fabric.

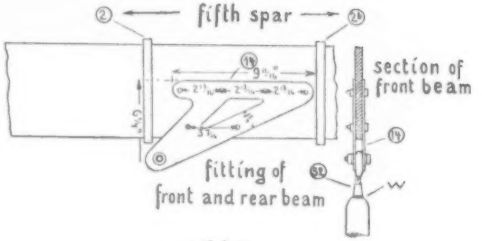
Weak bolts with fine thread (about 1/8 inch) suffice for the fastening of the hinge joint of the transversal rudders, such as are used in electrical engineering. Wood screws are naturally not suitable here. The hinge joints are fastened at regular intervals to the transversal rudders and then to the supporting wings. The two portions of the hinge joint themselves receive as axes a piece of wire about 1/16 inch thick, the projecting ends of which are bent over or riveted over.

For the sake of an easy handling of the cable, all pulleys should have a diameter as large as possible. In the present design rollers of 2 inch diameter were specified. The rollers have a deep round groove, so that the cable cannot jump out. With a correct construction of the roll fittings, however, a jumping-out of the cables is not possible. The rollers, which should be of aluminum, may be bought ready made in usable design. In order to avoid a breaking out of the bearings, suitable bushings of brass tubing are set in, while sections of steel tubing having the thinnest walls serve as axes. Naturally the brass bushing must be driven into the opening of the roller tightly, so that it cannot move. On the other hand, the section of steel tubing which serves as axis, should be easily movable and should be of such length that it can be passed through the corresponding drilled holes in the roller fittings and riveted over to fasten it.

The fitting (51) for the connection of the re-enforcing wires leading to the tail end, receives linings of sections of copper tubing similarly, as has been described for the segment of the transversal rudders. The purpose is to attain here a soft and rounded-off entering surface since without these precautions there is danger that the wires will break at the fitting under relatively small stresses.

The fittings for the connection of the stays (14) or rather the struts are alike in their exterior shape. A deviation between the fittings of the front and rear beam exists only in so far that the fitting for the rear beam is bent upward since, in contrast to that of the front beam, it serves for the connection of two struts. Above the openings for the taking up of the bolt of the strut, ring discs are soldered on hard, that is, soldered on with hard solder, to the outside of the fitting of the front beam, and to both the inside and outside of the fitting of the rear beam, so that the forces can be absorbed better by the bolts and so that the danger of a sheering off under very great exertions is avoided. The size and strength of these ring discs or washers depend upon the shape and size of the stretching or tightening screws which are welded into the ends of the struts.

The fitting (12) which holds the two rollers for the cables of the transversal rudder, consists of one piece of steel sheeting with four flaps of even size, which are bent to the inside at a right



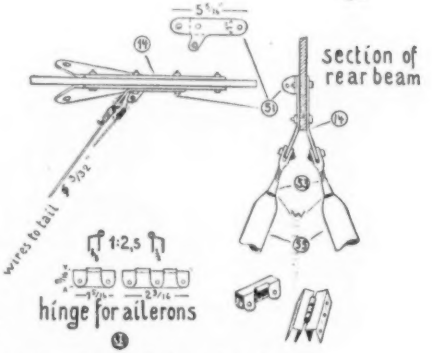


Fig. 6. Strut fitting for front and rear beam and hinge for aileron or transversal rudders.

Fig. 4. Fitting or shoe for rib ends.

Fig. 2. Lever or segment for aileron or transversal rudder.

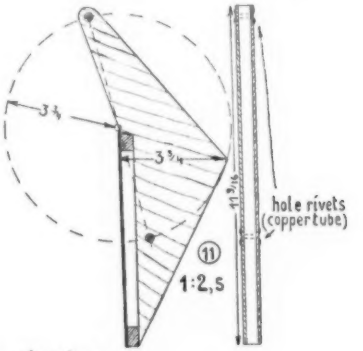


Fig. 1. Plan of wing showing fittings installed.

Fig. 5. Beam fitting to fuselage.

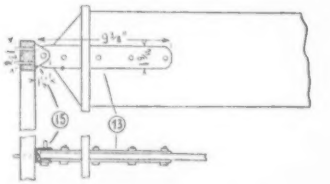
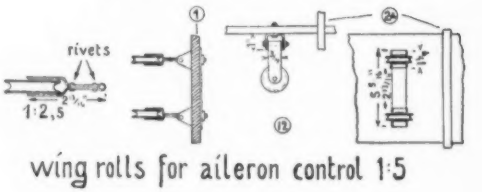
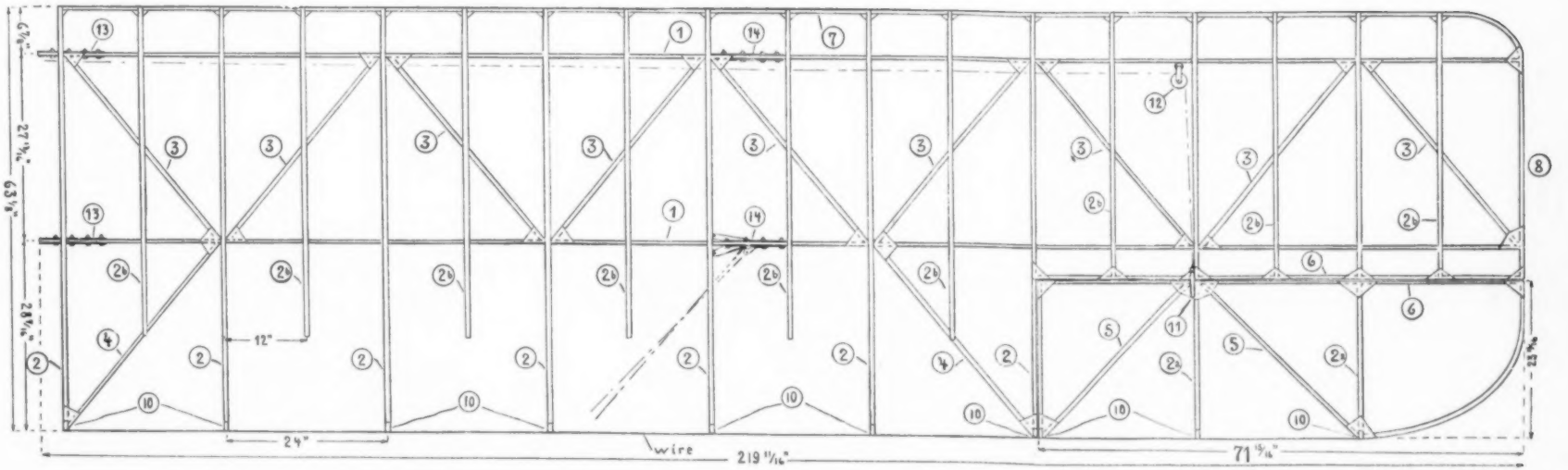


Fig. 3. Wing rolls for aileron or transversal rudder control.





Sailplane Construction

(Continued from page 82)

angle. In bending, care is to be taken that the bending takes place slowly and over a soft underlay. Sharp bends in the vice lead easily to cracks, but impede also in every case the strength of the fitting.

The ends of the ribs receive a shoe (10) made of sheet plate of 1/64 inch, which is tacked to each side of the rib ends by four wire pins. The 3/64 inch thick terminating or enclosing wire is drawn through the end opening (bent over a suitable piece of wire). It is best to use galvanized sheet and galvanized wire, in order to avoid the danger of corrosion as much as possible. The shoe of sheet plate and the wire are slightly soldered to each other after the wire has been tightened.

With this installment the building of the supporting wings is terminated. In the next installment we will deal with the building of the fuselage framework.

(To be continued)

Parts List

Quantity	Parts	Number	Material	Cross Section, in.	Length, in.
20	Shoes for rib ends	10	Sheet Metal	1/64	
2	Levers or segments of transversal rudder	11	Spruce with Plywood	5/8x11	9/16
4	Rolls with fittings for transversal rudders	12	Sheet Steel	3/64	
4	Beam connections	13			
2	Strut connections for front beam	14	Sheet Steel	3/32	
2	Strut connections for rear beam	14	Sheet Steel	3/32	
6	Hinge joints for transversal rudders	39	Sheet Steel	7/64	
2	Fittings for re-enforcing wires	51	Sheet Steel	3/64	
				3/32	

NOTICE

Aeronautics has a limited number of large size scale drawings of the Gymnich Sailplane, which will be sent postpaid to any reader for the sum of $5.00. A material list is included.

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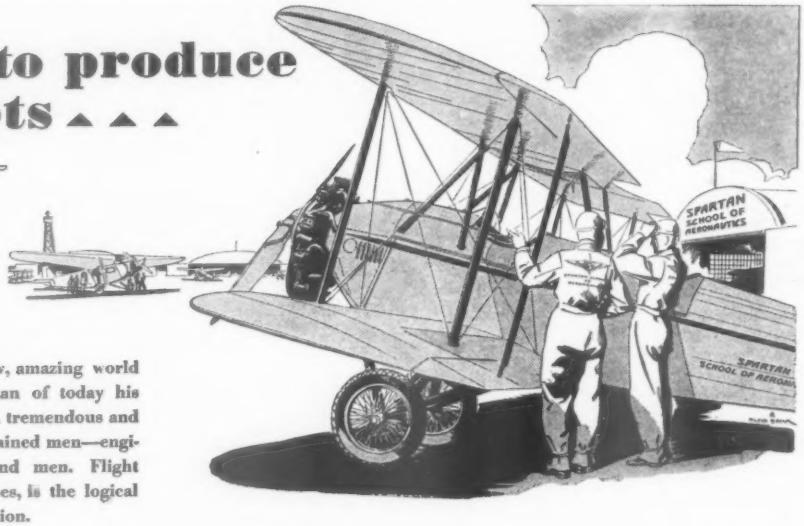

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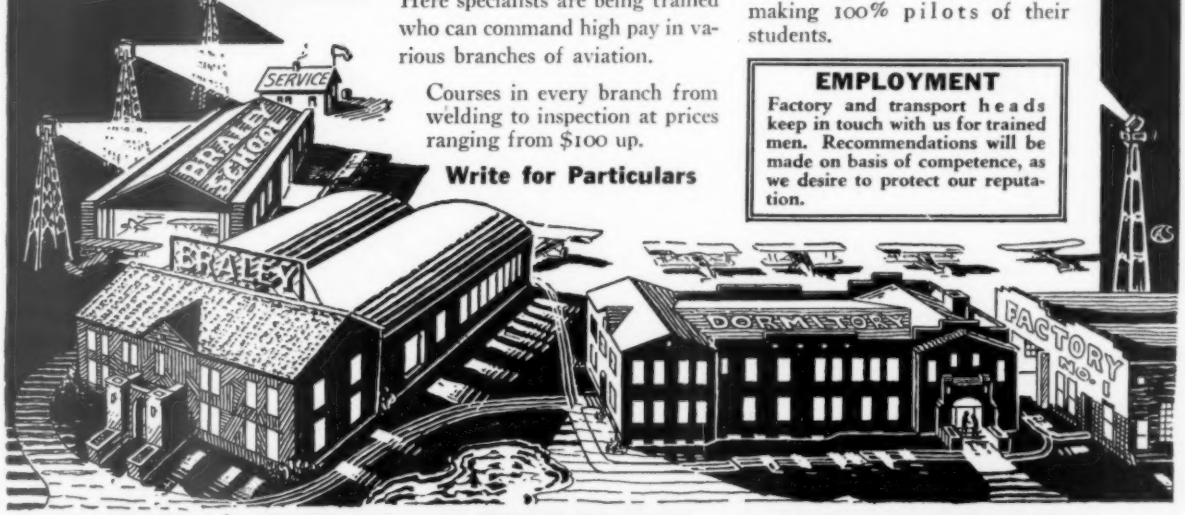

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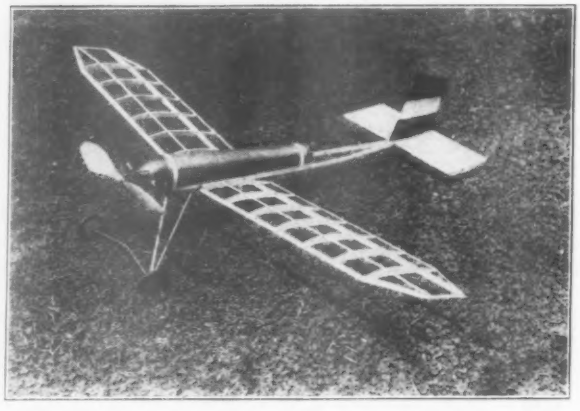


A Compressed Air Model

THIS is the first of a series of three articles on how to construct a real flying model airplane operated by a real compressed air power plant. The first section will describe the method of making the propeller and the air tank. The remaining two sections will be devoted to the construction of the powerful little one ounce three cylinder radial compressed air motor, the high lift wings and fuselage, assembling of the units and the operation of the completed ship.

At the National Playground Contest finals at Atlantic City last October, you will remember Virgil Rassner and Tudor Morris took first and second places respectively in the optional power event in spite of the high winds on the day of the contest. They even beat the rocket and spring driven models! This year the wing span permitted has been increased from 48" (too small for a good compressed air duration model) to 90" so real performances can be expected this year at the National finals at Louisville.

This light efficient model is a considerably improved design from the National Champion compressed air machines flown last year. This one is bigger, lighter, simpler and will give more duration when properly constructed.

Just imagine if you will, a large 4½ ft. compressed air model airplane purring through the air with the sunlight shining through its wings and imagine it climbing to a height until all of its compressed air power has been spent. Then perhaps a glide or circle a graceful dip and a perfect landing far away from the starting point. That is what I would call a real thrill and for those who have never constructed a compressed air model before I can truthfully say that there are very few things made in the workshop that can give the builder any more pleasure than a compressed air model airplane.

The first consideration in our compressed air model before we go into details is that of weight. Of course, if you put enough power on your model no matter how heavy it is, it would be possible to make it fly. This model is made light and still fairly sturdy to fly a long distance. In fact the whole machine should not weigh over 14 ounces. It is quite possible to build the machine to weigh around 10½ ounces.

You see, the more weight we must carry on our 4½ ft. wing the faster the model must fly and the more chance of some damage in case the model does not make a good landing. Of course, you understand there is no pilot aboard a model airplane; and only by the proper setting of the wings and the use of a sufficient amount of a dihedral angle are we able to keep the model balanced in flight. Also the faster the model must fly the more compressed air we must use out of our limited supply in the air tank to maintain the flight and consequently the duration would be less.

So that you will know what you are going to build, the main wings and framework of this model which will be described in a later issue are of the most modern materials and design. Balsa Wood is used almost exclusively. If materials and dimensions other than those specified are used the chances are that the model will be heavier than it should be or else considerably weaker and more fragile at such places where substitutions or changes in the size might be made.

Here it is well to call your attention to the fact that compressed air models have not yet been able to equal the flights of rubber driven models. You will remember the description of the 12½ minute Morris world record hydro two pusher model in the last issue. To the best knowledge of the author no compressed air model airplane has flown over 3 minutes over level ground. A model built as described will come very close to any record for compressed air models which may be in existence, officially or otherwise, as flights of well over a minute have been made. By making slight adjustments of the wings and by using the maximum pressure capacity of the tank, much longer flights can be made. No doubt in several years when compressed air models have been experimented with more they will come into their own and perhaps equal or even beat the records of the rubber driven models.

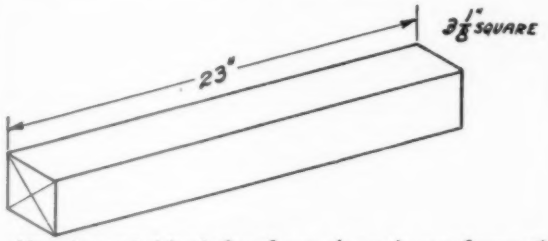
The Tank

The tank is the heart of the compressed air model airplane. It must be light enough that it will not over-burden the model and strong enough to carry sufficient air under pressure to give the midget whirlwind motor power enough to drive the model with a fair duration.

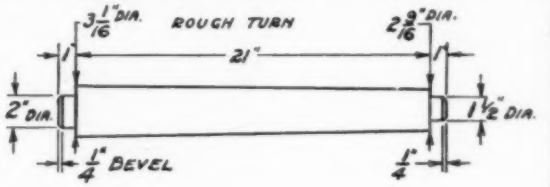
To build the tank as described, you will need the following materials:

1 sheet of brass .005" thick x 10" wide x 21¼" long.
1 thin brass or copper half-ball 3" in diameter for the large end of the tank.
1 thin brass or copper half-ball 2½" in diameter for the small end of the tank.
1 ordinary bicycle valve stem and core.
1 small throttle valve or one piece of ¼" diameter brass rod from which to make your own throttle valve.
1 roll (75 ft.) rustproof plated music wire No. 4 .013" in diameter.
1 small piece of high grade solder (radio solder is not very satisfactory as it is soft. What is known as 50-50 bar solder is easily obtainable at most any hardware store and it is more satisfactory). Resin or some high grade non-corrosive solder paste.

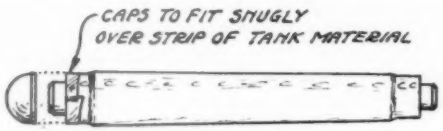
Tank for Compressed Air Model



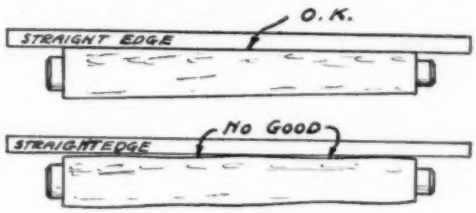
Hardwood block for form (maple preferred) Use 2 pieces glued together if necessary. (1)



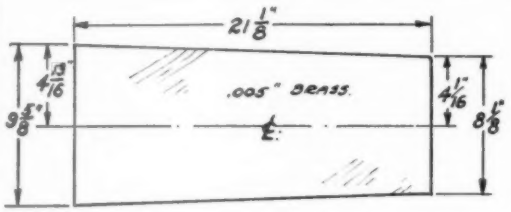
Turn ends & rough turn taper as shown. (2)



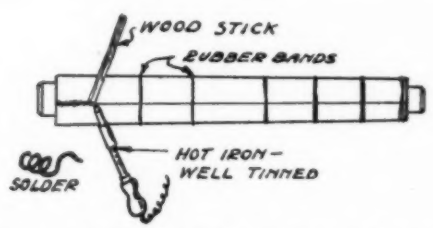
Turn & sand ends to exact size so caps just fit over strip of tank metal as shown. (3)



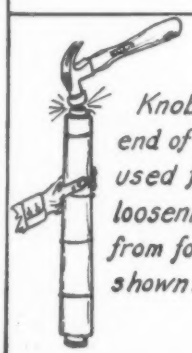
Finish form between ends - accurately! Taper must be uniform. Sand to exact size using straight edge to check. (4)



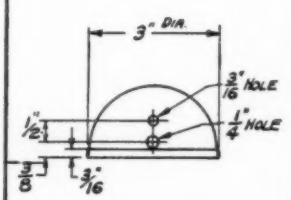
Cut brass to size. (5)



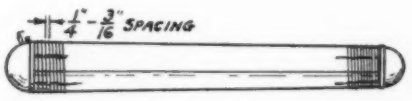
Give shell final check with caps & brass in place Tin edges & hold brass with rubber bands. Carefully solder seam - airtight. (6)



Knobs on end of form used for loosening shell from form - as shown. (7)



Holes in big tank end cap. (8)



Solder tank end caps & valves. Wind with #4-(.013") plated music wire. Test & seal all leaks. (9)

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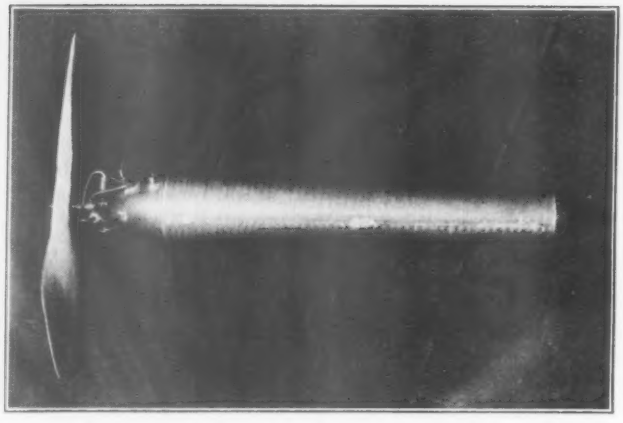
1 piece of wood at least 3⅛″ square x 23″ long from which to turn the tank form. A good grade of wood such as maple is advisable.

First gather up all of your materials before starting to assemble the air tank as it is necessary to use the tank heads or caps when turning the form over which the body or shell of the tank is formed. Refer to figures 1, 2, 3 & 4 and make the wooden form being careful to watch the following points. Read everything about the tank carefully before starting.



The completed tank with motor, propeller and valve attached.

1. First rough turn a tapered cylinder. (See Figure 2.)

2. Second, leave the main body of the cylinder 21″ long between faces, leaving knobs on the ends. Note: The knobs must clear the tank ends or half-balls.

3. The knobs shown on the ends of the form are used to drive the form out of the shell when you have soldered the shell seam together. (See Fig. 7.)

4. The taper on the form must be perfectly straight or the shell will not fit snugly to the form and it will be difficult to solder together and maintain the proper diameter at the ends so that the tank ends will slip over the shell snugly. (See Fig. 3.) To get the proper diameter at each end of the form you should wrap a small piece of the material to be used in the shell of the tank around the form lapping it ¼″ as you will do when you make the shell. If the half-balls or tank caps will just slip over the shell material wound around the end of the form as described with but very little looseness, you have the right diameter at the ends of your tank form. This is important as it is the key to making a neat tank successfully and quickly.

5. Then turn away the center part of your form so that a straight edge laid along the form will touch at every point including the two correct diameters which you have turned on each end. (See Fig. 4.)

6. As a final check after you have cut the piece of metal of the proper shape to form the shell of your tank (see Fig. 5) it is well to check the size of your form very carefully in the same manner as before by slipping the caps over the shell on the form, making sure that they do not fit too tightly or very loosely. If the balls fit just right you are now ready to go on with the assembly operation. (See Fig. 6.)

Cutting the Tank Shell

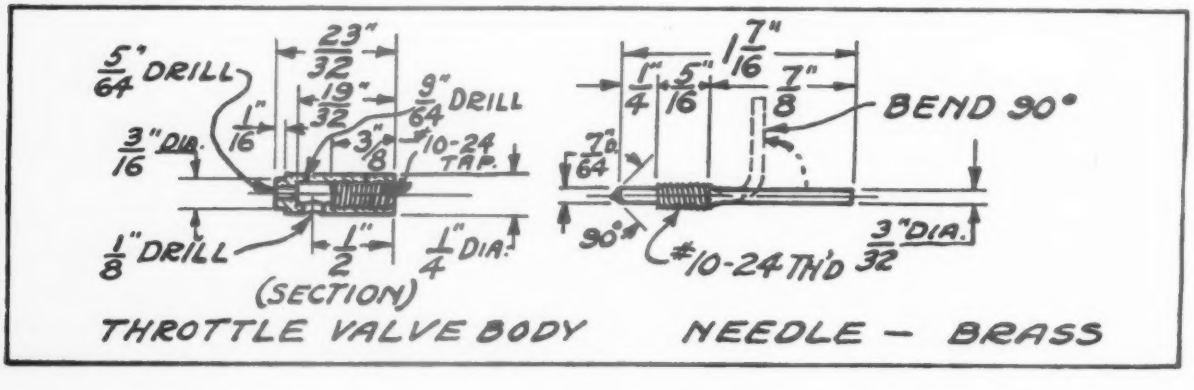
Take the piece of brass for the shell and cut it to the pattern shown in the drawing so that it is 8⅛″ wide at the small end and 9⅝″ wide at the large end. Then wind the brass around the form and with a sharp pointed instrument mark around inside of the ends and trim off the brass so that it just comes flush with the ends of the form all the way around. Then smooth out any rough edges which may have been caused in trimming.

With a hot soldering iron (a small electric iron will do if it gets hot enough) tin the edges of the tank shell for about ¼″ to 5/16″ in from each edge. Tin one edge on the top and the other edge on the bottom so that when the shell is rolled around the form the two tinned edges will be together. Then wind the tinned brass around the form holding it in place with 5 or 6 heavy rubber bands doubled if necessary. Then carefully sweat the seam together the full length of the shell. Be sure that the shell fits the form snugly and smoothly, otherwise in soldering the brass may buckle or pull away from the form at the ends.

You may find it advisable to loosen the shell occasionally from the form by holding the shell in your hand and rapping the small end with a hammer until the shell is loose. Then drive the form back in place by holding the shell and hitting the big end with a hammer and continuing soldering again. (See Fig. 7.)

If spring brass is used it often happens that because of the springiness of the material the brass will have to be held down with a wooden stick in the soldering operation until the solder cools. The heat of the iron traveling in the heat conductive metal will keep the solder soft for some distance away from the iron causing the brass to spring up and open the joint, if you do not hold the seam together with a stick while the solder cools. Then when you have done what you consider a good job of soldering remove the rubber bands and carefully examine the seam for any possible visible holes which might later cause air leaks and close any of these holes which you may find with solder. Remember that radio solder is not nearly as good as the harder tougher solder known as 50-50 solder used by radiator repairmen, etc. When you are satisfied that you have a good tight seam without any air holes and without much excessive solder, drive the form out of the shell gently being careful not to strike the sharp edges on the ends of the shell as this may damage them and make it difficult to fit the caps in place.

The next step is soldering the caps in



place. Carefully clean the insides of both caps and tin them. You will note that the caps shown in the drawing call for at least 3/16" length swell or shoulder at the rim. This swell should just stop up against the bottom of the shell. Also tin the outside of the shell for 1/4" on both ends. Then solder the cap in place making sure that it is slipped on as far as it is intended to go. Then with your hot soldering iron, carefully run solder all around the cap being careful not to heat the shell seam too much as it might open up right where the cap slips over the shell.

Before putting on the large cap you may find it advisable to make the holes for the throttle valve and the filler valve. For the filler valve a 1/4" hole should be made right next to the flange or swell on the cap as shown in the drawing. For the throttle valve, if you make one as shown, you should make a 3/16" hole in the large cap about 1/2" out from the filler valve hole. (See the drawing fig. 8.)

Now solder the large cap in place in the same manner as you did the small cap being careful not to loosen the soldered seam on the shell. Also be sure that the cap is on as far as it will go. Now check both caps carefully to be sure that there are no air holes and that you do not have too much excess solder. Solder, you know, is very heavy and you only want enough to join the parts together and fill the holes for any extra solder is dead weight and will cut down the duration of the flight of your completed model.

Be sure that you have removed the valve core from the filler valve before soldering it in place as there is rubber in the valve core which would be ruined by the heat of soldering it. It may be well to remove the needle valve from the throttle valve also in soldering. Solder these two valves securely in place filling all air holes and removing excess solder by either melting if off or scraping it off with a small 3 corner bearing scraper.

Now screw the needle valve and the valve core in place and pump about 25 to 50 pounds of air pressure in the tank with an ordinary bicycle or automobile hand pump. With a very wet cloth wipe down the seam and cap joints to locate any possible air holes. These must be sealed. Warning: You must let all of the air out of the tank before attempting to seal any air leaks. Be careful in sealing them that you use a piece of wood to hold the seam together as you solder. Of course, if you have done your job well there should be no more than one or two small holes to close.

Be careful not to put too much pressure in the tank before the tank is wound with wire as the soldered seam may open up slightly. However, if you have used the 1/4" to 5/16" seam as specified and tinned all parts carefully the tank should stand at least 60 to 80 pounds before being wound. A common automobile tire pressure gauge will be found very handy in checking the pressure.

Now with all of the air holes sealed you should again inflate the tank to about 40 to 50 pounds pressure and wind it with rustproof plated music wire. This should be done by hand by putting considerable tension in the wire as you wind. Carefully space the wire by eye as near to 3/16" or 1/4" as you can. The wire must be wound tightly or else it will allow the pressure to loosen up the seam later when the tank is inflated to full pressure. Plated wire was specified because it solders easily and also because it will not corrode readily and snap. The wire winding should extend the full length of the tank and if possible should be in one piece.

In winding by hand you will find it advisable to secure every 3 or 4 turns in place with a drop of solder. When the tank is wound all of the way you should solder the end of the wire in the solder where the cap joins the shell and very carefully cut it off after the solder

(Continued on page 86)

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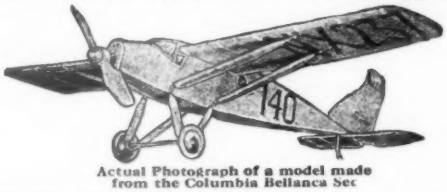

Actual Photograph of a model made from the Columbia Bellanca Sec

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Monthly Financial Review

(Continued from page 32)

Earnings and Miscellaneous Items

The United Aircraft & Transport Corporation reported earnings for the first quarter of 1929 of $1.10 per share on the Common Stock.

Western Air Express, Inc., reported earnings for the March quarter of 1929 equal to $3.06 per share.

Aeronautical Industries, Inc., reports for the four months ended April 30, 1929, earnings of $1.43 a share.

National Air Transport reported earnings of 21c per share for the first quarter of 1929.

Below is given the closing prices on various aeronautical stocks on the New York Stock Exchange and the New York Curb Market as of May the 17th, with the previous month's closings:

Mergers and Consolidations

The long awaited entrance of General Motors into the aviation industry has finally been announced. This step has involved the acquisition by the automobile manufacturing company of 400,000 shares of the Common Stock of the Fokker Aircraft Corporation of America. There are now 1,000,000 shares of this

	High 1929	Closing Apr. 19, 1929	Current May 17, 1929
*Curtiss Aeroplane & Motor Co.	173½	148⅝	154½
*United Aircraft & Transport Pfd.	109½	77⅞	94⅛
*United Aircraft & Transport	162	102¾	141
*Wright Aeronautical Corp.	299	247	128 (new)
**Aero Supply Mfg. Co. B. new	14⅞	....	14¼
**Aero Underwriters Corp.	48½	38⅛	39½
**Alexander Industries	23	16¼	18½
**Aviation Corporation of the Americas	89⅞	66¾	71⅞
**Aviation Corporation	23¼	20	21
**Aviation Credit Corp.	23⅝	18½	17¾
**Bellanca Aircraft Corp. of America	24	18½	19⅛
**Bendix Aviation Corp.	92⅜	....	91⅛
**E. W. Bliss Co.	57⅞	42⅜	48⅜
**Consolidated Aircraft Corp.	44⅝	31	43
**Consolidated Instrument Company	35	27½	33⅝
**Curtiss Aero Export	52⅞	42	40⅛
**Curtiss Flying Service, Inc.	29⅞	24⅛	25⅝
**Curtiss Reid Aircraft, Ltd., Pfd.	35	....	34
**Douglas Aircraft Co., Inc.	45½	30¾	41⅜
**Fairchild Aviation Corp.	34⅞	22	22⅜
**Fokker Aircraft Corp. of America	65	35¾	63⅜
**Irving Air Chute Co.	40⅞	24	38½
**Keystone Aircraft Corp.	50	38	36⅜
**National Aviation	88	71¼	73½
**Standard Steel Propeller	30	....	27
**North American Aviation	19½	16⅛	19
**Sikorsky Aviation Corp.	63⅞	51	47⅛
**Thompson Products Corp.	69¾	....	62½
**Transcontinental Air Transport	30⅞	26½	29½
**Travelair	61	45⅛	56⅛
**Universal Aviation	27⅜	18⅛	21¼
**Western Air Express Corp.	70⅞	58⅞	73¾

*New York Stock Exchange. **New York Curb Market.

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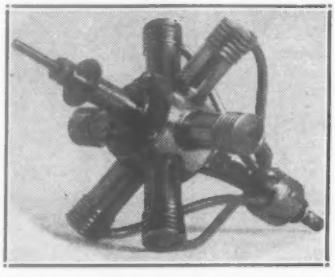

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PATENTS

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aircraft manufacturing concern outstanding, of which General Motors owns 40%, or undoubtedly enough with its allied interest to effect a complete control.

As the announcement was made very shortly before this writing, it is not possible to predict exactly what the developments will be, but it has been clearly indicated by the Hanshue interest of the Western Air Express, Inc., who previously controlled the Fokker Company, that the acquisition of a controlling interest by General Motors would involve the Fokker Aircraft Corporation only, and that General Motors was not interested in any transportation company.

In this connection, however, rumors have persistently arisen that the Wright Aeronautical Corporation has also come to terms with General Motors and that this premier motor manufacturing company will shortly be added to the controlled subsidiaries of the country's largest producer of motor cars.

In return for a controlling interest in the Fokker Company, General Motors will give the aeronautical concern complete control of the Dayton-Wright Company, heretofore owned by General Motors and largely forgotten of late by persons interested in the aviation industry. However, the Dayton-Wright Company owns numerous invaluable aeronautical patents and cannot help but be a great asset to the Fokker Company.

The Aviation Corporation reports that 90% of the stock required for deposit under its offer to acquire 51% of the stock of the Universal Aviation Corporation has already been deposited. During the month, the Aviation Corporation has also announced the acquisition of a substantial stock interest in both the Western Air Express, Inc., and the Aviation Corporation of the Americas, two of the country's most prominent and successful transport companies.

Acquisition has also been made of controlling stock in the Southern Air Transport, Inc., operators of airmail contract lines and passenger services throughout the south. Most of the company's activities are in Texas, but extend as far east as New Orleans and Atlanta.

United Aircraft & Transport Corporation has acquired control of the recently formed Stout Air Lines, Inc., operators of a regular passenger service between Detroit, Chicago and Cleveland. The main importance of this acquisition is not in the value of the company acquired, but rather is an indication that the United Aircraft & Transport Corporation is apparently laying its plans for a complete transcontinental air route, of which the Stout Air Lines is the first link to be added east of Chicago.

Know Your Weather

(Continued from page 24)

move at approximately 25 miles per hour. Both high and low pressure areas move eastward. In using the synoptic weather chart, as furnished by the weather bureau, these data are of considerable interest.

Fogs are similarly predictable to a certain extent. They are most likely to occur in summer along the Atlantic coast from Maine north to Newfoundland and beyond. In the winter they occur most frequently in the southern states. During the late winter and spring they are encountered throughout the Middle Atlantic and New England states generally. California experiences fogs all through the year in mountainous regions and along the coast.

In answering the question "What is the best kind of day to fly?" we see by referring to our map once more that for us in the east, at any rate, a high area east of the great central valleys with the isobars or lines of equal barometric pressure neither too close together nor too steep, and with both highs and lows of a moderate intensity is desirable. Under these conditions no bumpy experiences due to strong puffy winds are likely.

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Flight Training the Navy

By K. M. Painter

(Continued from page 36)

ing is followed by practicing torpedo runs in SC's. Since torpedoes must be dropped from as low an altitude as is safely possible, preliminary practice in low-flying is necessary. After the pilot has perfected his judgment in flying low without "stubbing his toe" on a wave, he makes dummy torpedo drops. These are made in front of the squadron hangar so that the instructor on shore may criticise his method. The essentials for a good drop are: Lowest possible speed at a height of less than ten feet, and nose pulled slightly upward when the torpedo is dropped.

Considerable practice is usually needed to bring the student to the point where he is qualified as a torpedo-plane pilot. The nature of the mission, however, is such that practice is by no means unpleasant. Torpedo flying has the lure of hedgehopping, with the added thrill of discharging a missile at a mark.

Torpedo attacks in echelon formation are practiced on the Massachusetts though no torpedoes are dropped since the water there is too shallow. These attacks are started about three miles distant from the target and phantom drops are made when the plane has come within about a mile of its goal. After the drop, the formation practices breaking up in such a way as to present the most difficult target for the enemy. Two hours of night flying ends the training in Squadron Three—the Torpedo and Bombing Squadron—and successful students are promoted to Squadron Five, to learn scouting and observation tactics.

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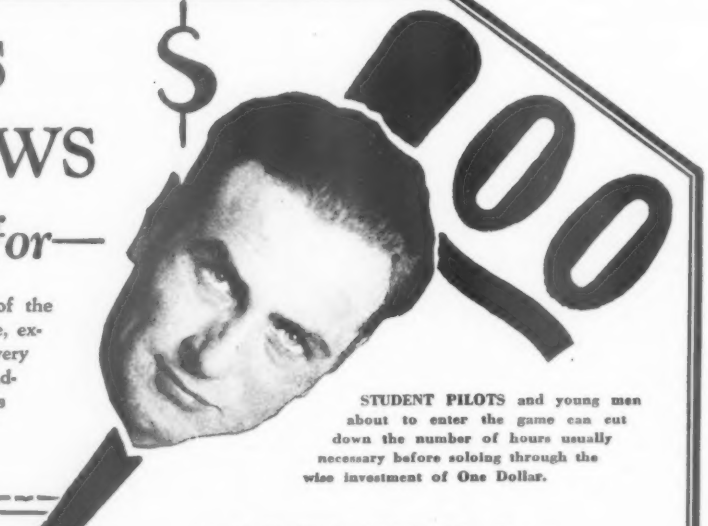

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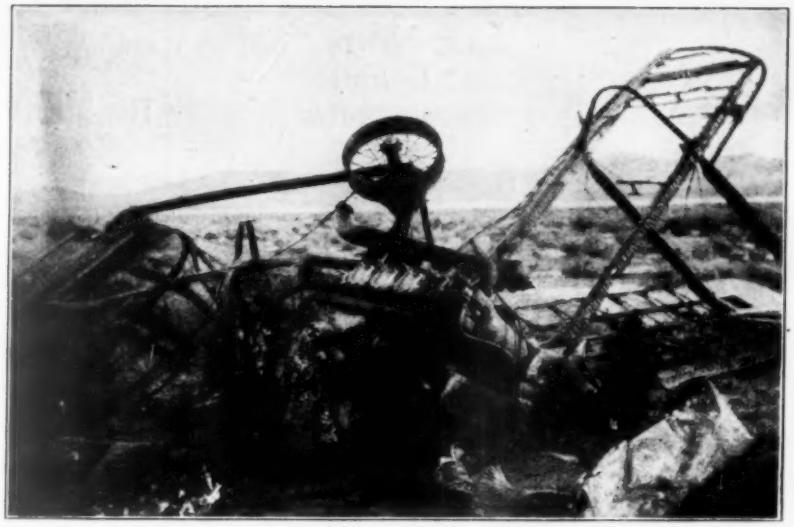


Fire!

By Paul Scott

A Forced Landing Story

A crash is bad but a fire is worse. The pilot escaped, however, and so did the mail. This Forced Landing Story contains more than its share of thrills.

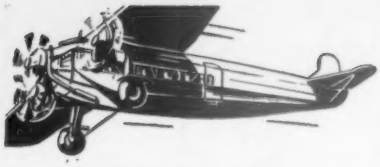
THE number of the ship was 313, bad luck figures to superstitious pilots, but to me only a number. Pilots that hold a superstition should not fly, as that superstition is bound to overtake them sooner or later. The rabbit's foot will be forgotten or the owl's claw left behind. Misery creeps up on them, they worry their motors into quitting or themselves into such a nervous state that one snowflake seems to be a squall, a molehill a mountain. My habit of carrying a straw hat in the pilot's cupboard of a plane was always letting me down until I nailed one in the ship. Now with these cabin planes a straw hat just lends the proper sartorial effect. The red-blooded He-Man can now don spats and wear a monocle, and, if so inclined, write poetry. But I'm telling a story, so on with the dance:

Left Reno, plane 313, August 2, 1924, 11:30 A. M., with mail for eastern points. Ten minutes later over the winding and twisting Truckee River Canyon, where the turbulent river on leaving the mountain gorge calms itself and northward flows serenely into Pyramid Lake. The lake was called Pyramid by Captain Fremont because of three pyramid islands. Alongside of this lake is Winnemucca Lake, named after old Chief Winnemucca, who with keen strategy and much zest wiped out Captain Wadsworth and every member of his fighting band. From the town of Wadsworth to Battle Mountain nothing but rugged mountains and barren sands—distance 180 miles.

Carson Sink, that lake of sand and mud, where the Humboldt River disappears into the bowels of the earth. Legends of quicksand, massacres, starvation, but Kit Carson always guided them safely through. More sand and sagebrush, more mountains; then the railroad track and Battle Mountain. Battle Mountain, because here again the Indians jumped the immigrant trains trekking west and put them to precipitous flight, heading east. Over Beowawe, through Palisade Canyon, past Carlin and over the Juniper Range to drop into Elko two hours and twenty minutes later for oil, gas and a few minutes' rest. (Taking a long time for this fire to break out, but the longer it takes the better, if you are in the plane.)

One hundred in the shade at Elko; heat, dry heat that parches the skin and cracks the lips. Sweltering in a flying suit, anxious to be up in the cool again. Off at 2:10 P. M. across the Humboldt River with a steady climb to 11,000 feet so as to clear the Ruby Mountain Range. Flying suit comfortable. Look at that train and the trail of dust crawling over the desert! Fat men mopping fevered brows; stout women cursing corsets. Won't be long until such travel will only be a memory. Over Red Eagle Range; cracked up there once when it was 40 below on the ground—a close call. Over Shafter, an emergency landing field; a haven in a blizzard with a warm fire. And the Jap section men do make good saki. Through Silver Zone Pass, by Pilot Mountain into the desert of Great Salt Lake. Sand, sand, with mountains for islands. The salt beds, 25 miles square, 20 feet thick, solid salt, whiter than white and reflecting the glare of the sun stronger than a mirror. A landing here difficult; cannot look down; feel and guess, stall and feel. Salt beds behind, more sand, nothing but sand and heat, where nothing can live. Bones, bones of horses, cattle and sheep; bones of dogs, bones that were once skeletons of men, women and children. Sagebrush again underneath, and ranches. Thunderstorm ahead, right in path. That will break the monotony; ship needs washing anyhow after all that dust in Elko. Black clouds to the right and left with gray streamers hanging to the ground, vertical lightning hurtling to earth, chain lightning zigzagging back and forth. Whirlwinds racing, making funnels of dust conjoining at the top like a cluster of toadstools; violent gusts of wind, updrafts, downdrafts, eddies, bumps. Boreas doing all his tricks. Big drops of rain splashing on windshield, on goggles, and stinging face. The wind dies down. Fine misty rain, then solid sheets of water. Visibility obscure, farms and fields distorted and grotesque. Live stock huddled together and sullen. Drizzling misty

(Continued on page 93)



Get Into Aviation

Good Positions waiting for Trained Men

The era of Commercial Aviation has arrived. 1929-1930 will see the most substantial development this industry has ever known. The call is for men—*trained men*—who can take responsible positions in this rapidly growing industry and share in its certain future.

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Lady Heath Cup Contest

(Continued from page 33)

It will be seen from the above conditions that this contest is a simple one. Any woman is eligible who has not had previous instruction. Any type of light plane may be used, provided it does not weigh more than 880 pounds empty. Instruction may start at any moment after 12:01 A. M., July 4. There are no limitations or restrictions as to the amount of time to be spent in either dual or solo flying.

The candidate must be sufficiently advanced to perform the maneuvers specified in Condition #4. These maneuvers should be carried out in the presence of the school head, the instructor, and the two pilots mentioned in Condition #5 so that the proper affidavits may be executed.

The affidavits should be sworn to before a notary by the required persons and mailed to AERONAUTICS magazine immediately.

The prize of the silver cup and the $100.00 in cash will be given to the first one who completes the requirements. This decision will be based on the time element only. If one candidate completes her course and complies with all the above conditions by, say 12:05 P. M. on July 5, she will win over the candidate whose affidavits show the conditions were complied with by 12:06 P. M. of July 5. The prizes will be given to the woman who learns to fly *first* after midnight of July 3-4, *not* to the one who learns to fly in the shortest elapsed time.

Undoubtedly there will be many entrants who will endeavor to set up a record of speed in this contest and we advise for this reason that each candidate follow her instruction with as few interruptions as possible.

The announcement of the award will be made as soon as practicable in the columns of this magazine.

May we point out that there is a very sportsmanlike attitude displayed by Lady Heath in her offer of this prize? She is employed by a firm manufacturing light airplane engines, but has thrown open this contest to any student on light planes, regardless of the make of plane or engine.

AERONAUTICS wishes to call the attention of all women and schools considering entering this contest to the fact that grave harm may result from training which is forced ahead to hastily. A premature solo may do more than disqualify the candidate. No premium is placed on the number of hours actually required in the air to qualify the candidate.

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MANN & BENTON, Box M, Chillicothe, Ohio

I Could Fly—Just Give Me a Plane

(Continued from page 50)

breeches, and a firm intention of showing him that Lady Heath has a rival.

It was my first venture in a seaplane, but I signed the slip entitling me to no funeral expenses in case of disaster, and thanked my lucky stars that my husband is a Naval aviator. Only through such ties can a woman fly in a Navy plane, and the idea prompting this magnanimity is to prove the safety of aviation and allay any nervous strain a wife may feel when she knows her husband is in the air. Such a purpose indicates the sort of stuffy flight one may expect, the safe sort of flight that is nerve-racking because of its dullness. But my pilot had promised to do stunts, and let me fly. I think in my case he was trying to instill a proper respect for the dangers of flight.

One of the N-Y training planes was waiting on the beach when I reached the primary training station, and I was told to step only on that part of the plane which was painted black—the rest of the plane is painted yellow, to indicate that it is a training ship. I was more than careful about my footing.

I was pleased to see that the instructor was as awkward as I in crawling along the wing. "All set?" he queried, and from the depths I echoed a faint affirmative. We taxied down Pensacola Bay, and I was so busy watching the rudder and stick move under his direction that I entirely missed a crash that happened less than five hundred feet away.

With the grace of a ten-ton caterpillar we took off. Up, up, up, we went, and I looked at the altimeter which was above and to the left of the pilot. It registered 3,000 feet. I was higher up in the world than I had ever been before, and I was all set to enjoy this superiority, when zip, zoom, zah, we were whirling and pitching earthward in a tail spin. I kept faith. When we were within about a thousand feet of the water, boom, boom, boom, went the engine, and we were heading up again before I knew what it was all about. My pilot handed me a note which commanded: "Try to lift your feet when I signal." He waited until we had climbed above 3,000 feet again, and made what I thought was a left turn, but turned out to be a left flipper spiral. He waved his hand, and I put forth all energy in an attempt to raise my feet. Flop, they went back against the floor-boards, and I seemed to be pushing the plane down beneath me.

We went down as before, and climbed again. I was just about to shake the stick to indicate that I wanted to take the controls when my pilot turned off the motor and leaning back to me, said, "Blaa, blaa, blaa, blaa, blaa," pointing enthusiastically beneath us. I looked over the side and saw the Country Club. The next series of blaas showed me the apartment house in which we live, and then came the first understandable sentence. He had hooked up his Gosport, and was talking through the tube, "Take the controls." I did! Now I've never done a spit-ess, a falling leaf, a barrel-roll, or an Immelman turn, and I thought that was my chance, for I knew the principle or theory of flight. I yanked the stick back, and pushed hard on the left rudder, but all we did was make a pretty turn. I tried the right side with no better results—I wasn't strong enough to make the plane barrel-roll—and then decided that straight flying would prove my ability better.

Meanwhile, the pilot was waving his hands in midair and going through the maneuvers that are supposed to establish confidence in the student. I was sorry that I didn't have the speaking tube instead of the ear-phones, so that there would be no doubt as to the uselessness of this procedure. I wasn't thrilled, it was just so much formula to me. I made a few more banked turns, and then glided down for a landing, but my instructor was too quick for me. He took the controls and hoarsely whispered through the Gosport, "I'd better land it." He won't commit himself on my ability, he only says I displayed more nerve than he's ever found in a new student. But I say, women would make better pilots than men. They have more sense of balance and poise. I could fly—just give me a plane!

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1/16" x 1" x 3'		.06
1/8" x 1/2" x 3'	.03	.033
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1/4" x 1/2" x 3'	.054	.06
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A Compressed Air Model

(Continued from page 79)

is cooled. If you again touch your hot iron to the end of this wire it will melt the solder and the springiness of the wire will cause it to come loose.

If you have the use of a fairly large lathe you may want to wind the wire on the tank in the lathe. This can be done by making balsa wood blocks with pockets into which the tank heads just fit with a notch in the block fitting over the large end to catch the valves and to rotate the tank. This block for the large end should be the one which is placed in the chuck because it drives the tank in winding.

Some may even wish to set the lead screw of the lathe at 3/16" to 1/4" per revolution and space the wire very accurately and neatly in this manner, by guiding it through a notch in a block of wood fastened to the moving tool post. The lathe should be run at a slow speed if you use this method of winding the tank and you should stop the lathe and solder the wire every 10 or 12 turns.

The important things to remember in winding the tank are to keep the wire under a little tension and to space it as evenly as possible and to fasten the ends down securely. So that the turns do not slip or become loosened by sliding down the taper of the tank, you should solder the wires to the tank by running two streams of solder lengthwise of the tank using a very hot iron, a good flux and plenty of solder on the iron for this operation. Warning: Do not attempt to solder the wires down along the seam as this may tend to loosen the seam and cause air leaks.

Now you should give your tank a final check for air leaks and carefully seal any that are found. After everything has been found okay your tank is ready to operate at 90 to 110 pounds pressure with complete safety.

You may call your tank completed but for appearance sake the author suggests that you clean off all oil, grease and flux from the tank, using a rag moistened with gasoline.

With the tank completed the most particular job and important part of the whole model is completed. The propeller, which we will take up next, and the other parts of the machine can be made and assembled very easily.

The most difficult and exacting part of a piece of work is always best done at the beginning, when one's enthusiasm is at its highest point. With the tank ready for use we are all set to finish up our job.

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BECKER'S

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From the Publisher's Quill

(Continued from page 9)

Commercial aviation can only go as far as the business man and general citizen will support it and take advantage of its benefits. Haphazard and undirected publicity of the type now given is not calculated to advance the price of aeronautical stock to any startling degree.

[redacted] avenue, Waukegan.

Plane Starts Backfiring.

The backfiring of the motor was the first warning of trouble the men said they noticed. Buffeted by the storm, the plane fell in a spinning nose dive, landing on its nose.

Wiley and Miller rushed to the scene of the disaster. They rushed Hobbs and Kern to the hospitals. Kern regained consciousness sufficiently to speak shortly after arriving there. He said that he remembered that the plane was falling, but nothing else

Had Passed Pilot's Test.

Hobbs had had 300 hours flying experience and had passed the pilot's physical examination preparatory to taking out his license next week. He had flown the plane from the Chicago municipal airport three days ago.

The plane belonged to Mark Smith, 3010 Emmaus avenue, Zion, who has been taking flying lessons in Chicago, preparing to fly it himself. Smith acquired it second hand three months ago, and it had been out of the factory of the [redacted] Aircraft company [redacted] eleven months.

It was equipped with an 8 cylinder V-type [redacted] water cooled motor. The overall span was 30 feet and the length was 24 feet. The plane was pronounced in first class condition when it was removed from the Chicago airport by Hobbs.

◆

GENERAL GROVES, Honorable Secretary General of the Air League of the British Empire, gives Germany credit for showing the most remarkable advance in the development of commercial aviation, and the United States for developing the most completely equipped airway in the world—the New York-San Francisco route.

◆

EIGHT air mail contractors reported to the government that they made a profit on operations which averaged more than 28 percent on their investments.

◆

MERGERS and interlocking directorates among the operating companies bid fair to rival the electrical industry for complexity. The latest is the virtual division of the territory of this hemisphere by two of the greatest.

◆

MAJOR YOUNG, just returned from Europe, again reiterates that we must learn from Europe to pay attention to details and refinements about passenger handling. It should be obvious to operators that the air traveling public has money and insists on comfort. Six uncomfortable seats as against four upholstered chairs might be one trifling detail.

◆

DIRECTOR MERKEL of the Lufthausa says that Europe must have Duty-free airports in order to keep pace with our commercial aviation development.

◆

HENRY FORD predicted at the Detroit Show that shortly production of airplanes will be in the hands of a few big corporations. The trouble lies in guessing which ones.

◆

FRANCIS KEALLY points a good warning to communities building airports, in the experience of London, which had to scrap a $600,000 plant in a little more than a year, and replace it with one costing $1,000,000. It pays to consult experts.

◆

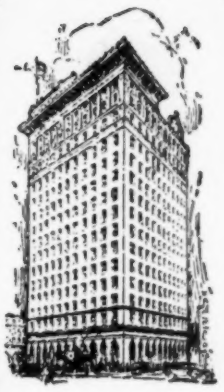
PROFESSOR KLEMIN'S plea for standard performance tests should be welcomed by the purchasers, who are frequently lost in the fog of conflicting statements of competing manufacturers —all of whom are telling the truth, but from different angles.

◆

THE AIR CORPS will have room for about sixty-five second lieutenants on September first, and practically all of them who survive can look forward to being first lieutenants about 1950, if the separate promotion bill does not pass.

◆

PROPOSED REGULATIONS on air traffic may make the use of radio a requirement for large transports, and one company is looking far enough ahead to have secured its transmitting station and twenty licenses.



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MINIATURE AIRCRAFT CORP.
83 Low Terrace New Brighton, N. Y.

Sky Pilotage

(Continued from page 68)

medium and vice versa. A ray coming from the sun passes through the thin upper air to the dense atmosphere of the earth, and in doing so becomes curved downward, and it is this curve that we have to correct.

The amount of refraction correction of course varies with the altitude of the body observed, being nil at the zenith where the rays are perpendicular and at a maximum near the horizon where the rays pass through the atmosphere at a sharp angle. It is this element of refraction that makes altitude observations of bodies when less than 10° or 13° above the horizon undesirable.

Dip, often referred to as dip of the horizon or "height of eye," is the correction due to the height of the observer above the plane of the sensible horizon. The sensible horizon is a plane passing through the eye of the observer at right angles to a freely suspended plumb line, and it is to this horizon that all observations are reduced.

The last of our five corrections to observe altitude is parallax, which is the correction rendered necessary by the fact that whereas all altitude observations are reduced to the sensible horizon, they should in reality be referred to the rational horizon which is parallel to the sensible, but passes through the centre of the earth.

We now have collected and explained all the necessary factors for the computation of latitude by meridian altitude. Latitude may be defined as "the arc of the meridian extending from the equator" to the place in question and the altitude of the elevated pole above the true horizon is the observer's latitude; the altitude of the pole being constant at any given point on the earth. The following diagram from Lecky will make this clear.

Z represents the zenith of the observer at O, N the nadir, PP the poles, EQ the equator, HH′ the horizon. The outer circle is the celestial concave, and the shaded portion the earth, projected on the plane of the meridian.

Now PE is equal to 90, and ZH′ is equal to 90; therefore, PE is equal to ZH′. Take away the common part ZP. Then ZE is equal to PH′, or the latitude is equal to the altitude of the elevated pole.

The above holds good for all meridian altitudes which are of course taken at noon in the case of the sun and at the moment of meridian crossing in the case of planet, star or the moon. In our somewhat stormy latitudes it frequently happens that clouds intervene between the observer and the object he is "shooting" just at the critical moment, and consequently a meridian altitude is lost. This may be averted by using what in the United States is called a circum-meridian observation and in Great Britain an "ex-meridian." This method is extremely simple. The ordinary procedure for taking a meridian altitude is

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carried out and a correction always aditive is made to the altitude and equal to the amount of rise and fall between the time of observation and the time of culmination. Tables for facilitating this computation are found in Bowditch but the tables compiled by Brent, Walters & Williams give a much larger range.

The principles that are involved in the calculation of latitude having been outlined let us now consider longitude. Latitude without longitude merely gives us a line of position and not a "fix."

Time, which is certainly a factor in the determination of latitude, becomes all-important in the determination of longitude. Longitude may be defined as the arc of the equator between the meridian of Greenwich (the first or zero meridian) and the meridian of the place referred to, and is measured in arc by degrees, minutes, and seconds or in time by hours, minutes, and seconds. Alternatively it could be described as the angle at the pole included between the meridian of the place and the first meridian, the meridians of course all converging at the pole. Due to this convergence the degree of longitude has different values, according to the latitude in which it is measured. A degree of longitude on the equator equals 60 nautical miles and at the poles longitude ceases to exist, and the sun always bears due south or due north. Although miles has just been used in connection with longitude, it is incorrect to speak of miles of longitude in anything but degrees, minutes and seconds of arc or hours, minutes and seconds of time.

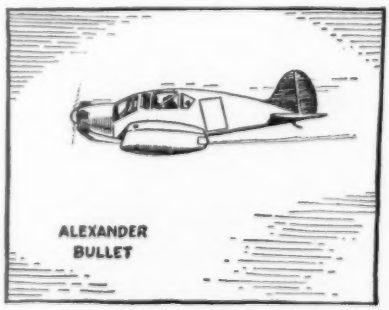
The sun appears to move around the earth in its diurnal motion covering 360° in 24 hours, whether the declination is north or south, and thus it covers 15° of longitude in one hour in all latitudes, or 1° every 4 minutes. This establishes a definite relation between time and arc (° ′ ″) and they are interchangeable by a very simple process. Hence if we have the time at Greenwich from our chronometer, and know a little about spherical trigonometry, we can determine the time at our own position, and the difference between the two represents longitude in time, which can be readily converted to arc.

This problem in trigonometry involves a spherical triangle with its apex at the pole, the polar distance (90 less the declination of body observed) as one side, the co-latitude (90—dead reckoning latitude) as a second side and the zenith distance (90—the altitude of body observed) as the third. With any three elements of a triangle the remainder may be computed. The most important element to the navigator is the angle at the pole, which is the hour angle and enables the navigator to obtain his local time. This is known as the "time sight" formula and can be studied in detail, in Bowditch and elsewhere.

This triangle varies with the declination of the body and its altitude, the latitude of the observer and the hour angle and no formula will produce the same degree of accuracy in all the various figures. This is just the fault of the time sight formula which is rapidly becoming obsolete even with the most conservative of seamen. The variations of the shape of the triangle and their effect on accuracy are tabulated below:

High latitudes declination of body over 90	Detract from accuracy
When bearing of body is nearly east or west and is rising or falling faster than at other times	Favorable to exact results. Errors in latitude and altitude producing only slight error in longitude obtained
When azimuth of body is less than 46 or exceeds 135	Calculations wholly unreliable

It was these and similar uncertainties that led to the adoption of what has come to be known as "New Navigation." Capt. Sumner, a Boston shipmaster, was the father of the "New Navigation" and the first recorded instance of its use was made by him in 1827. Admiral Marc St. Hilaire, Johnson and a host of others have contributed to the modern position lines methods but to Sumner be the "honor and glory." Discussing the method of double altitudes founded by Capt. Sumner, Lord Kelvin said "that it would be the greatest blessing to navigators, both young and old, if every other method of ordinary navigation could be swept away."



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The Airplane Finds Oil

(Continued from page 18)

Bosnia and Herzegovina. First, the harassed aerial photographer must consult a big atlas to find out where he is expected to operate, and provide himself with a ship big enough and fast enough to get him there from a temporary field perhaps 200 miles away, operate for a couple of hours at, say, 18,000 ft., and get back over those same 200 miles to the field before the gas tank runs dry.

The oil industry has gone in for aviation in a big way. Not much has been said about the manner of their "taking off," so to speak, but nearly every big producing and distributing company in the country now owns and operates from one plane to a whole fleet, often with distinctive colorings and insignia; large aerial photographic concerns, such as the Fairchild Aerial Surveys, Inc., of New York, find more and more of their time being taken up with oil company contracts. Pipe lines from large producing centers to cities and seaboard ports are laid out from airplane maps; patrolled by airplane; visited by officials who arrive in company-owned ships. There is an instance of the gigantic corporation which uses a stock monoplane as a flying laboratory in which to test aviation fuel. The transcontinental speed record was broken because Captain Frank Hawks, an official of an oil company in addition to being one of the country's crack pilots, had important business in New York which required the fastest trip across the country ever made. The oil companies are not interested in aviation for any thrills or publicity; it's a matter of cold cash and actual time saved. The enormous increase in aviation activity on the part of the various oil concerns means simply that the airplane is paying its way and demonstrating clean-cut, impersonal efficiency.

In some cases the airplane has saved the entire situation for more than one oil company, and accomplished results which could have been achieved in no other way. In Mexico, for example, with important oil developments delayed and interfered with due to revolution; with many lines of communication with the United States cut off and making it obviously impossible for a surveying party to operate, the aerial camera has brought back its pictures and maps; completed its contracts on schedule and told geologists who sat at mahogany desks in New York, three thousand miles away, the story of the surface of the earth in a war-torn, turbulent republic. In spite of a delay of six days due to investigations by Mexican officials, two Fairchild photographic crews have gone ahead with their map-making schedules and brought back the completed product.

Again the airplane demonstrated not its possibilities, but its achievements—not its theoretical value, but its necessity. The airplane has found oil; and the oil companies have found the airplane!

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Picked Up in Hangars

(Continued from page 29)

transport companies to dock in the river near the Drive. She complained, and vigorously, too, and the Mayor raised ned with the particular board that issued the temporary permit. In vain did the air transport company plead that the craft took off and landed in the middle of the river, that the engines were muffled, and that they came to the landing stage under complete control and with no more fuss than a motor launch. They even brought forward the fact that the flying boats would add beauty and interest to the scene. This last was a mistake. There is quite enough of beauty and interest in the river along Riverside Drive. There are the mud scows, garbage scows, and smoky tugs, emblems of progress and civilization. But flying boats—mere innovations!

OUR fellow editor, Mr. C. C. Grey of the Aeroplane, closes a recent editorial with a plea for standardized instrument boards. He says that pilots are apt to get somewhat absent minded and mistake one instrument for another, and he refers to the story of a pilot, flying blind, who crashed into a brick wall, because he thought he was flying at 1,800 feet when it was 1,800 r.p.m.

DOWN at France Field, Panama Canal Zone, Dr. S. M. Burka, who is on duty at the Material Division, Wright Field, recently stirred up quite a commotion, according to the Air Corps News letter. The first night that Dr. Burka went up to test some new equipment devised for taking photographs in the dark he forgot the fact that the natives of Panama had never witnessed bombing exercises, and he forgot to advise everyone concerned of his experiment. The result was that his flash bombs scared the population into the belief that some enemy was dropping bombs in an attempt upon the canal. One officer called and said, "This is Lieutenant Blank of the Umpteenth Infantry, the Officer of the Day. I wish you would inform those (certified) crazy Air Corps pilots to be more careful in the future when they are hauling bombs. One of them just dropped one in Captain Whoosis' back yard as he passed a few minutes ago. Fortunately no serious damage was done, but the results could have been serious." Then the wires started humming and the switchboard at France Field could not accommodate the calls that came in from everyone from the Commanding General, the Governor of the Canal, down to the cops on beat in Balboa, who all insisted that the Air Corps was bombing the defenseless population. Oh, yes, Dr. Burka's experiment was successful.

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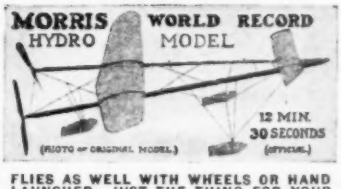

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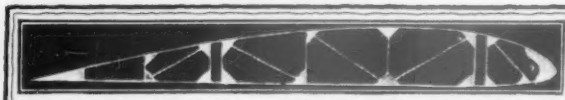

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Fire!

(Continued from page 83)

rain once more. A dagger thrust of light, more violent gusts, calmness, lambent streaks, dazzling sunshine. Mountain peaks sunning themselves after a bath. On beyond Great Salt Lake, shimmering in the distance. Live stock frisking, pelicans flying company front, seagulls rout order. Now over the lake for thirty-five miles, the most beautiful and enjoyable part of the run. The air smooth above the placid water, requiring no effort to keep on an even keel, and cool down low. In the distance the majestic Wasatch Range with drifts of snow hiding in secluded nooks.

Motor meter acting queer; 80 degrees, 90, 180, 212 and back to 80, circles dial twice. A flash to my stomach and a tingling at my ankles. I know that radio; means danger and fear. A geyser of steam and water, duck low in cockpit, radiator exploded. Can I make it to the shore? Push, brother, push! Parachute no good. With all of that harness and flying suit on will have a tough time in that brine. Can't drown, just strangle and choke to death. Push, friend, push! Motor very hot and sputtering, revs dropped off to 800. Not far to go, but will she get there? Shellac frying—how I hate that smell—black smoke, a flame. Pulled pressure Pyrene; it helped. Revs down to 600; flame picking up again. Another flash to stomach and ankles. Believe am going to make the shore. Push hard, push hard, kid! By Saltair Pavilion, water behind, now mud. Close throttle, cut gas at Lukenheimer, release air, wipe smoke from goggles, cut switches, land. Pancaked, rolled a few feet forward and up on her nose she went—good—; if she'd go on over on her back I might have been pinned in. Hand Pyrene soon empty; flames mounting—get the mail. The ship—I'll need a new one.

Threw mail to ground; relayed it about 100 feet through the mud. Eyebrows singed, face and hands blistered, nearly overcome with smoke, exhausted. Got outside of smoke and heat and lay on ground to rest. Gas tanks explode, flames shooting 50 feet high and the sky black with smoke. The good ship 313 going up again, her last flight, never to come back down.

People running from the beach: bathing beauties and scrawny men. Wonder what all the excitement's about? Throw mail in automobile and start for field. Getting hungry; a little exercise whets the appetite. Arrive field one hour late; report made to Manager O'Leary. Mail loaded in plane 328 and Collision pulls out for Cheyenne, chafing at the bit for being held up.

O'Leary's wire to Col. Paul Henderson (2d. asst. Postmaster General at Washington) and to Mr. C. F. Egge (General Superintendent at Omaha):

"Radiator 313 exploded while Scott over Great Salt Lake en route Salt Lake from Elko. Motor caught fire account overheating. Scott checked fire with pressure Pyrene until reached shore. Left wing then on fire. With hand Pyrene Scott held fire back sufficiently to recover mail, placing same 50 feet from ship. Scott OK except skin burns. Not serious. Scott carried 16 pouches, weight 262.

"O'Leary."

Wire from Mr. Egge:

Paul Scott, Pilot Air Mail Service, Salt Lake City, Utah. Personal.

"Colonel Henderson and I wish to commend you for splendid work August second. Period. That kind of action will make our service success. Am proud of you Scotty. Best regards.

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(Mr. Egge never failed to have a word of commendation for the pilot after a crackup and the pilot never failed to appreciate and to be encouraged by this kindliness.)

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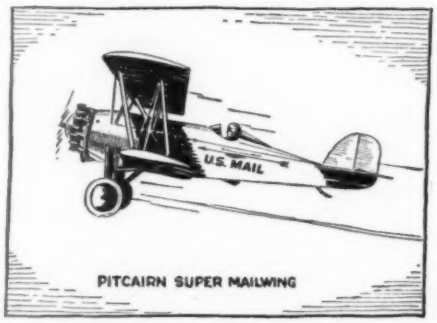

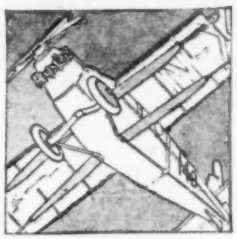

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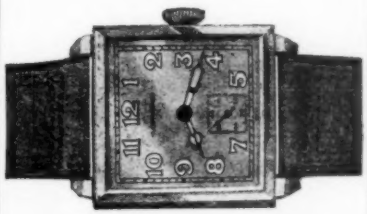

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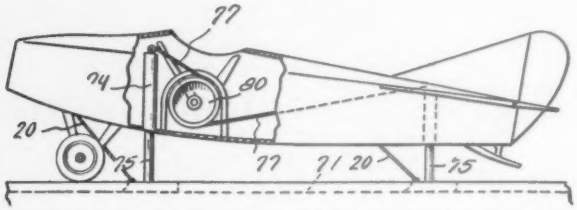
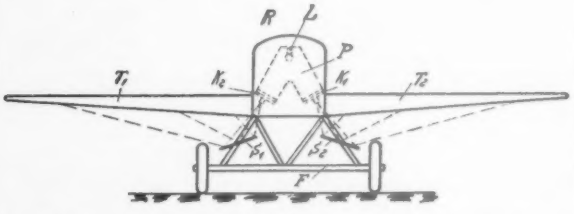
Patent Department

No. 1,710,290, Landing Mechanism for Aeroplanes, patented April 23, 1929, by John Enloe Broyles, of Entiat, Washington.



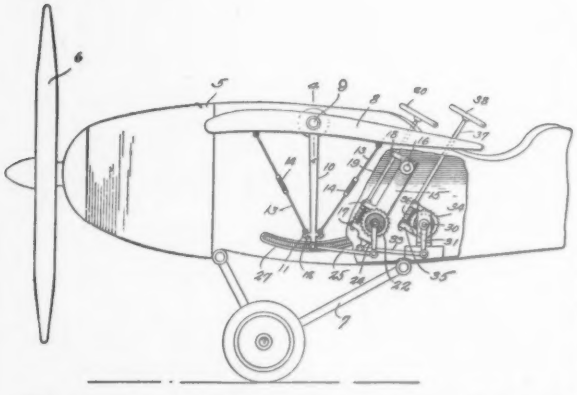
It is claimed that equipped with this mechanism, the aeroplane may land on the roof of a building without the necessity of coasting a considerable distance. The spring-equipped brake wings extend outwardly for frictional engagement with a recessed trackway.

No. 1,709,620, Signalling and Projecting Images on Aerial Craft, patented April 16, 1929, by Hugo Junkers, of Dessau, Germany.



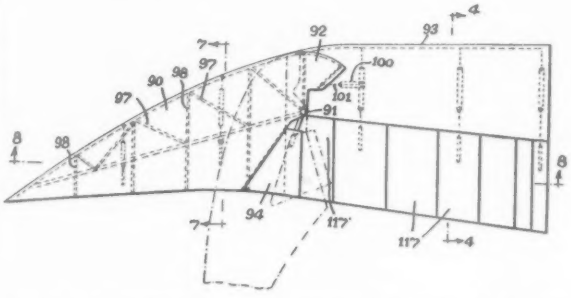
The inventor does away with incandescent lamps, heavy frames and the like, and provides a projection apparatus, mounted in the fuselage of the flying machine, comprising a single source of light, two optical systems directed downwardly at an angle to each other, a mirror below each optical system in a position to reflect the image onto a bearing plane.

No. 1,710,137, Adjustable Wing for Aeroplanes, patented April 23, 1929, by John C. Bankston, of Shreveport, Louisiana.



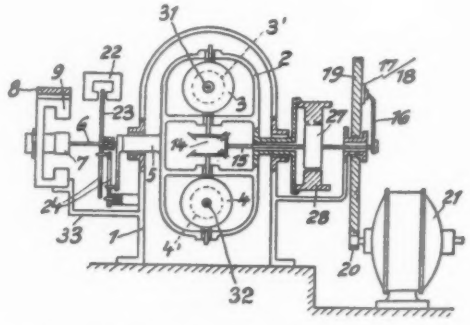
The primary object of the invention is to provide an operating mechanism which may be operated to adjust the wings simultaneously or independently of each other, the adjusting mechanism being such as to be readily and easily operated. The operating mechanism includes a rectangular pivoted frame, shafts mounted on the frame and having worms, gears mounted on the frame and meshing with the worms, means for transmitting movement of the gears to the wings to operate the wings independently of each other.

No. 1,710,673, Aeroplane Wing or Aerofoil Structure, patented April 23, 1929, by Leonard W. Bonney, of Flushing, New York; Flora MacDonald Bonney, Executrix of said Leonard W. Bonney, Deceased.



In this invention the wing construction includes a main frame member extending longitudinally of the wing and a flexible trailing portion carried by the main frame member including a plurality of individually adjustable featherlike aerofoil portions which are adjustable about axes transverse to the line of flight, each feather including an individual yielding and controlling mechanism disposed on the interior thereof.

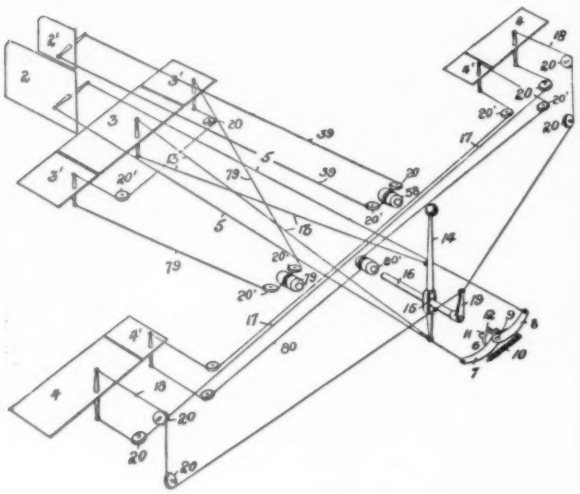
No. 1,709,457, Stabilization of Moving Objects Such as Aircraft and Water Craft, patented April 16, 1929, by Johann Maria Boykow, of Berlin-Lichterfelde, Germany, Assignor to Messgerate Boykow, G. M. B. H. of Berlin-Lichterfelde-West, Germany, a corporation.



This invention relates to damped stabilization of moving objects such as aircraft and water craft, relatively to a given stabilization value, independently of the local field of total acceleration. In an aircraft or water craft for instance, such a stabilization value is for example its position of equilibrium, its speed, its direction of travel, its altitude. The apparatus comprises two gyroscopes of the same impulse and rotating in opposite directions, rockingly mounted on a frame secured to the aircraft, an instrument for measuring the state

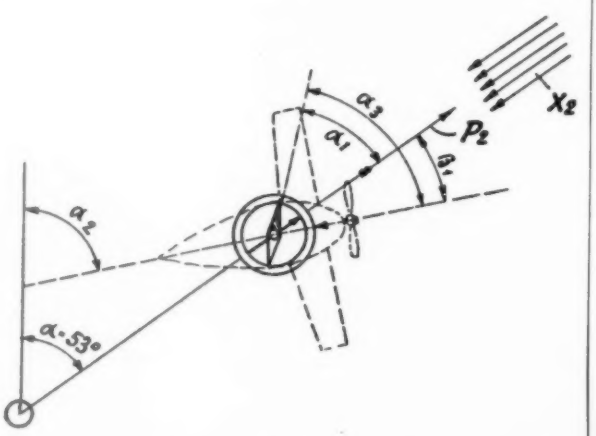
of motion of the aircraft independently of the aggregate of accelerating forces, means intermediate the measuring instrument and gyroscope frame for rocking the latter, and means for operatively connecting the gyroscopes with a controlling member on the aircraft.

No. 1,707,690, AUTOMATIC PILOT FOR AIRPLANES, Patented April 2, 1929, by Lawrence B. Sperry, of Garden City, New York, Assignor, by Mesne Assignments, to Sperry Gyroscope Company, Inc., a corporation of New York.



The inventor has provided, in addition to the usual control surfaces operable directly by the aviator, a separate auxiliary set of automatically operated control surfaces, the operation of the automatically operated control surfaces having less effect upon the airplane than the operation of the control surfaces which are operated directly by the aviator. In this manner the effect of the automatic control can be modified to such an extent that the movement of the airplane in any plane can be controlled by the operator directly regardless of the action of the automatic control surfaces, but at the same time the advantages of automatic stabilization in all planes are retained.

No. 1,709,621, METHOD AND MEANS FOR NAVIGATING AIRCRAFT, patented April 16, 1929, by Hugo Junkers, of Dessau, Germany.



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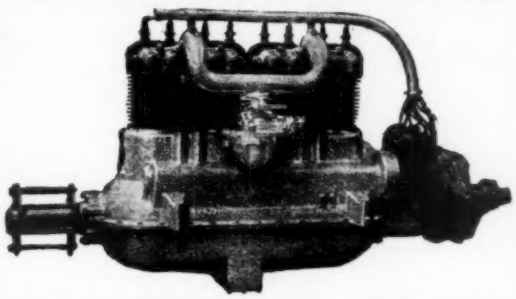

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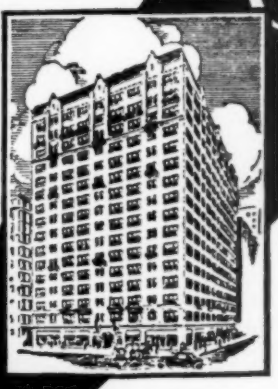

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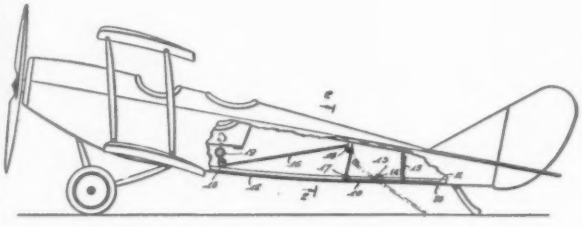
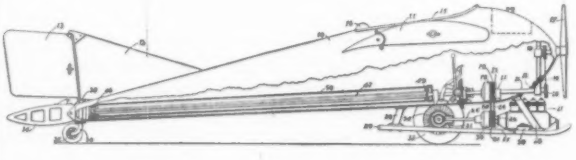
the craft is flying, are produced by optical means, that further direction of displacement of ground rendered visible by the wandering of the image of ground is transferred either mechanically or optically onto the image of the compass, and that the craft is then steered so as to assume the position in which the direction of the displacement of the ground image coincides with the direction, ascertainable from the image of the compass, of the deviationless course.

No. 1,710,628, BRAKE FOR AEROPLANES, patented April 23, 1929, by John H. Kessler, of Nyack, New York.



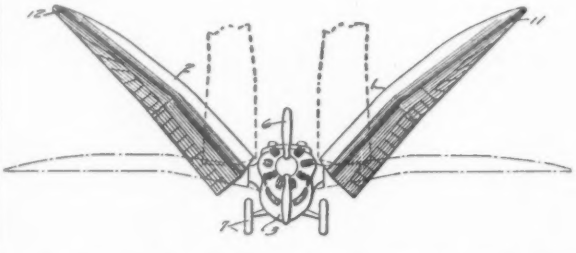
The general object of this invention is to provide a drag brake normally affording no projection beyond the surface of the fuselage, but having means to throw the brake to a position to cause it to engage the ground and offer resistance to the forward movement of the aeroplane.

No. 1,708,249, AIRPLANE, Patented April 9, 1929, by Carl C. Abel, of Rockford, Illinois, Assignor of One-Fifth to J. P. Jensen, of Rockford, Illinois.



In this invention, the object is to provide, in effect, a powered glider, that is, an airplane the power plant of which is just capable of sustaining the plane in flight at a relatively low flying speed, the power plant being in fact hardly capable of accomplishing the take-off of the plane without the aid of supplemental power provided by a driving connection for the landing wheels.

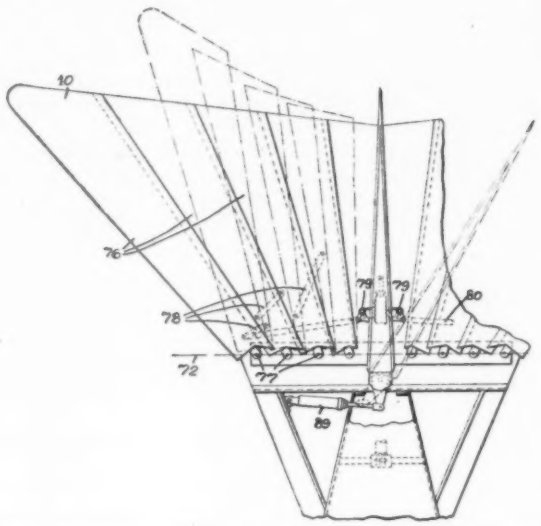
No. 1,710,670, AEROPLANE, patented April 23, 1929, by Leonard W. Bonney, of Flushing, New York; Flora MacDonald Bonney, Executrix of said Leonard W. Bonney, deceased.



This construction includes a wing support structure which is continuous from tip to tip and rotatably carried about a central support whereby the angle of incidence of the wing may be varied at will, the end portions of the wing structure

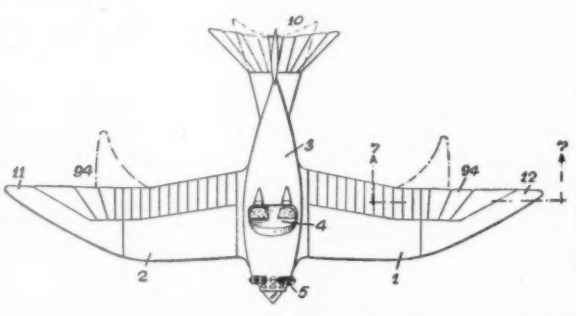
being also adjustable with reference to the central portion for variations in the dihedral angle and mechanisms under the control of the pilot whereby both the angle of incidence and the dihedral angle may be substantially increased at the same time.

No. 1,710,671, AEROPLANE CONTROL, patented April 23, 1929, by Leonard W. Bonney of Flushing, New York; Flora MacDonald Bonney, Executrix of said Leonard W. Bonney, deceased.



The control includes a number of pivoted and telescopically arranged fan or blade-like members together, with connections therebetween causing the simultaneous closing and opening movements thereof, a pivotal mounting for the elevator whereby the elevator element may be moved upward and downward for effecting the longitudinal control movements, and additional means whereby the fan or bladelike members may be reefed or opened at the will of the operator without interfering with the elevator control.

No. 1,710,672, AEROPLANE CONTROL, patented April 23, 1929, by Leonard W. Bonney, of Flushing, New York; Flora MacDonald Bonney, Executrix of said Leonard W. Bonney, deceased.



This invention relates to ailerons for aeroplanes and the assembly comprises a plurality of relatively pivoted and telescopically arranged feather members, one of the members constituting the extreme tip of the wing and pivoted to the wing frame and pivoted connecting links between the various feather-like members for effecting a gradually increasing pivotal movement from the innermost to the outermost feather-like members, and means for actuating the feather-like members to close and open the same.

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CHAPTER FIVE — Construction of Airplanes
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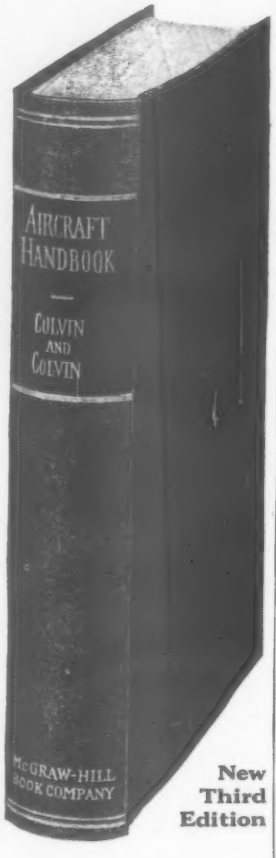

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Aero Corp. of California... 92
Aero Model Company..... 99
Aeronautica 92
Air Activities 55
Airplane Spruce Co..... 80
Airtech Training School... 92
Alexander Aircraft Company 82, 100
American Eagle Aircraft Corp. 41
American School of Aviation 73
Aviation Engineering School 92
Aviation Financing and Trading 81

Becker's 86
Bennett Flying School..... 57
Berry Brothers 5
Braley School of Flying, Inc. 75

Cessna Aircraft Co..... 40
Cleveland Model & Supply Co. 82
Command-Aire, Inc. 4
Doyle Aero Corp..... 91
Du Page Flying Academy.. 55

Eagle Airport School of Aviation 92

Fairchild Aviation Corp.... 3
Fleischmann Trans. Co..... 85
Flug-woche 92

Gordon & Ferguson, Inc.... 89
Greer College 59
Guardian Air College..... 74

Hawthorne Model Aero Corp. 82
Heath Airplane Co..... 86
Henley, Norman P., Pub. Co. 49, 63, 96
Hotels:
Carlton 86
Clift 87
Drake 86
McCormick 95
Manger 88

International Engineering Corp. 88

Johnson Company 88

Lancaster & Allwine....86, 92
Lincoln Airplane School.... 79

McGraw-Hill Book Co..... 98
McMullen Aviation School.. 92
Mann & Benton..... 84
Marshall Flying School, Inc. 61
Mason, Fenwick & Lawrence 82
Melvin Mfg. Co..... 84
Midwest Airways 92
Miniature Aircraft Corp..80, 87
Model Airplane Supply.... 84

National Aero Corp..... 95
National Aviation Training 84
Naturaline Co., of America 2
Nicholas Beazley Airplane Co., Inc. 43

O'Brien, Clarence A. 80

Pacific Technical University 91
Parks Air College..... 69
Paxton Lumber Co..... 92
Peru Model Airplane Shop. 91
Pickwick Airways 92
Polachek, Z. H. 87

Robinson, H. S., & Co..... 80
Ronald Press Co..... 47
Roth-Downs Airways, Inc... 97
Ryan, T. C., Flying School.. 90

Selley Mfg. Co..... 79
Simplex Air Model Co..... 85
Spartan School of Aeronautics 72
Star Aircraft Co..... 96
Swallow Airplane Co..... 40

T. A. T. Flying School..... 64
Texas Pacific Coal & Oil Co. 10
Travel Air Co..... 39

Universal Aviation Schools 52, 53
Universal Model Aircraft... 89

Von Hoffman Aircraft School 67

Westchester Airport Corp. Flying School 92
Whittelsey Mfg. Co.....44, 45
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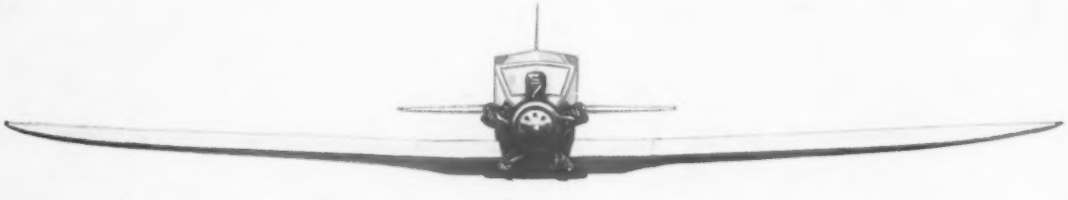
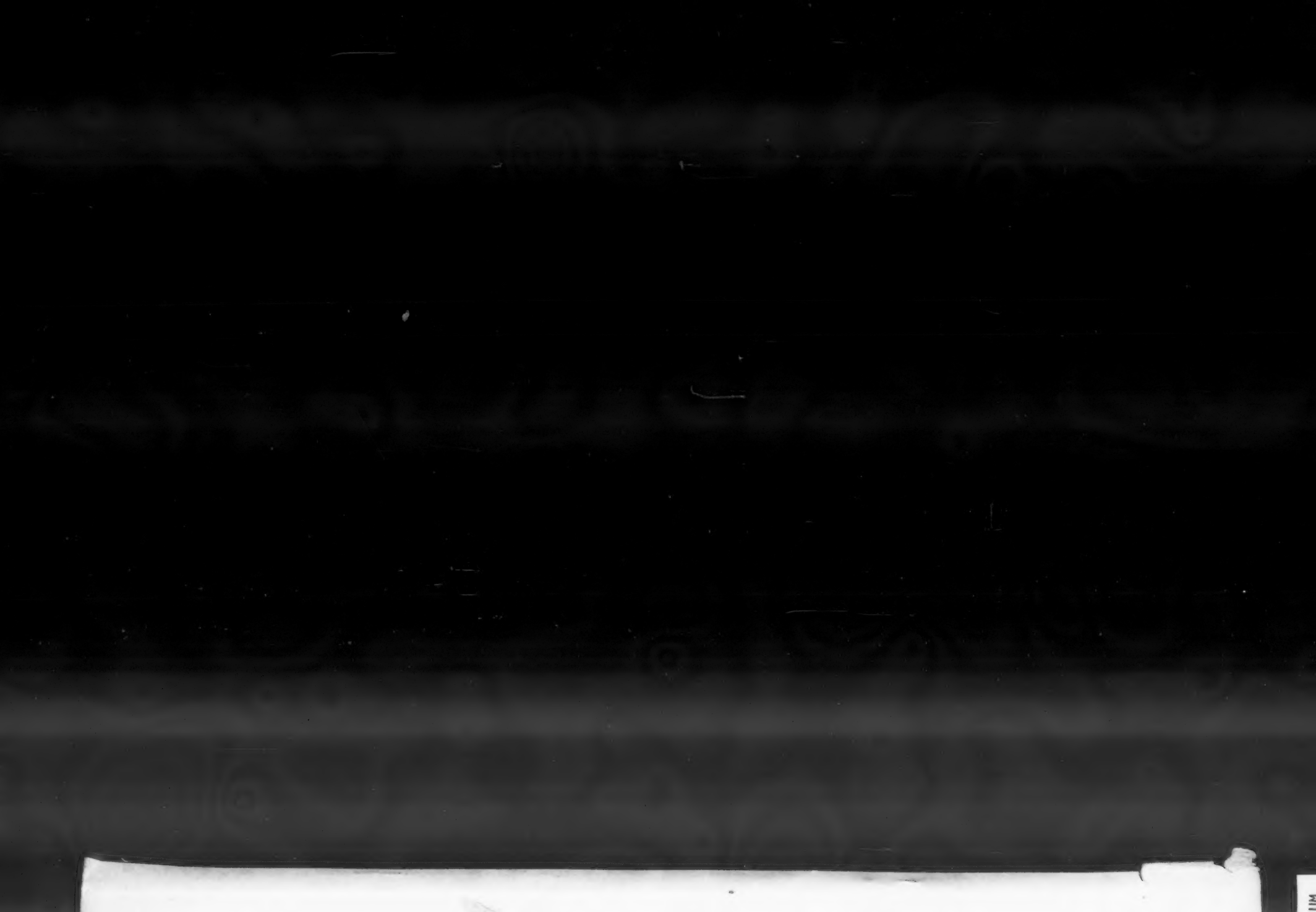
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